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The Use of 35/32mm Films for the Production of 16mm Black-and-White or Color Prints

By WILLIAM E. GEPHART, JR.

This paper describes a method of using 35/32 films for the production of 16mm prints which has been successfully used by the General Film Laboratories. The advantages of this particular procedure are that it permits use of 35mm professional equipment, is economical and generally produces good quality 16mm product. The technique of using 35/32mm films in the various processing steps is presented, including the requirement of special printing machines. Assembly, cleaning and developing are accomplished on normal 35mm equipment, and inspection is done on 35/32mm projectors designed for the purpose. The 35/32mm prints are slit for 16mm for final inspection and assembly. A high degree of quality control is necessary in using 35/32mm films, particularly in slitting, for which a new precision slitter is used. Increased use of the 35/32mm method is predicted.

THE INCREASED use of 16mm films for professional purposes, as in television and motion-picture features, has encouraged many attempts to utilize 35mm film handling equipment and 35mm film for the production of 16mm prints. Such a practice is beneficial since most of the original negative is 35mm and most of the professional equipment in use today was designed to handle 35mm films.

Figure 1 shows the 35/32mm film and its dimensional characteristics. This is 35mm film, perforated with 32mm sprocket holes so that two 16mm prints may be split from the center, the 1½-mm surplus being trimmed from the edges. Film manufacturers currently supply a number of 35mm emulsion types with this kind of perforation.

The use of 35/32mm films as negatives and the use of 32mm print films has been described in a paper by La Grande, Daily and Bruce Denney.[1] This paper is concerned with the extended use of 35/32mm film for dupes or internegatives, and more particularly, its use for print purposes in the production of 16mm prints. For a number of years, attempts to use 35/32mm films for print purposes have met with variable success due to the lack of good slitting equipment. Since using a new precision slitter, described in an accompanying paper,[2] General Film Laboratories Corp. has, over a two-year period, processed millions of feet of 16mm film from 35/32mm raw stock with successful results.

Presented on October 9, 1956, at the Society's Convention at Los Angeles by William E. Gephart, Jr., General Film Laboratories Corp., 1546 N. Argyle Ave., Hollywood 28.

(This paper was received on October 25, 1956.)

Advantages of Using 35/32mm Films

There are a number of advantages to be gained by using 35/32mm films for the production of 16mm prints. Some of these are shared by the 32mm method now used by several laboratories. The advantages in common with 32mm method of making 16mm prints are: better sound quality, lack of roller abrasions in the soundtrack area, less physical distortion of the film, and the economy of handling two prints in a single operation.

The 35/32mm method has a decided advantage over other procedures in that it can be handled on normal 35mm nonsprocket-drive developing machines along with other 35mm material, and benefits from the good solutions control and mechanical maintenance normally practiced on these machines. Large savings can be realized by not having to duplicate for 16mm or 32mm width films the costly 35mm developing machines. This is important because 35/32-mm films are currently handled for several purposes which require separate solutions and differing machine requirements such as:

(1) Variable-area sound negative,
(2) Variable-density sound negatives,
(3) Black-and-white picture negative,
(4) Color negative,
(5) Color positive,
(6) Black-and-white positive, and
(7) Black-and-white low-contrast positive.

Any two of these requirements cannot be met in a single developing machine without solution changes that are expensive and cumbersome.

The advantage of the added width of 35/32mm is apparent when one considers that the distance between the sprocket holes and the edge of the film in 16mm or 32mm is small — 0.036 in. The extra 1½mm existing on the 35/32mm films throughout processing gives roller support, edge guiding, and protection to the finished product. Roller marks, rough edges, abrasions and dirt that might get into the picture area are slit off and discarded, thus presenting a new smooth edge. Physical distortions of the film edges such as fluting and spoking are usually prevented.

Negatives made on 35/32mm film stand the wear and handling of multiple printing much better than 16mm negatives, due to the added width which gives support to the sprocket holes. Since most of the processing steps are accomplished with the 35mm width

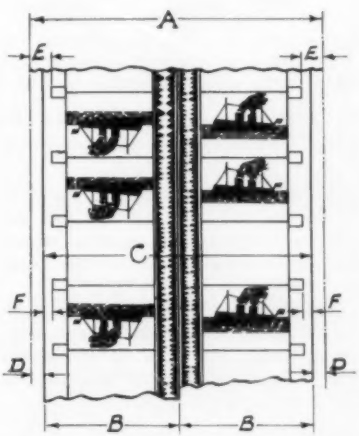

Fig. 1. Dimensional characteristics of 35/32mm film; code:

A — 35mm . . 1.377 in.
B — 16mm . . 0.629 in.
C — 32mm . . 1.258 in.
D — 1½mm Edge . . . . 0.060 in.
E — 35/32 Perf. Edge Distance . . . 0.096 in.
F — 16 Perf. Edge Distance . . . . . 0.036 in.

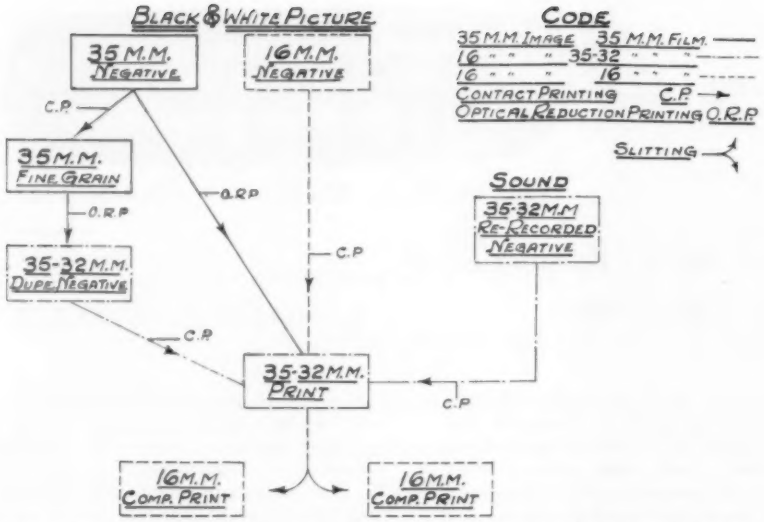

Fig. 2. Processing steps for the production of 16mm prints from black-and-white negatives by 35/32mm method.

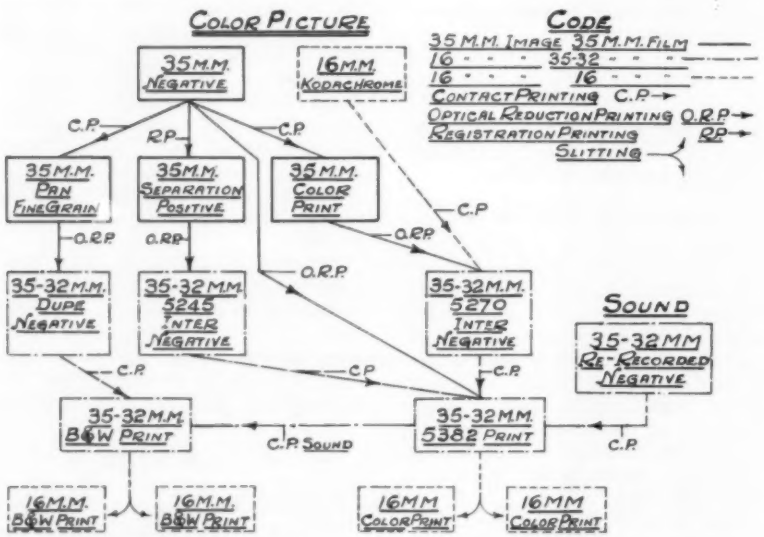

Fig. 3. Processing sequence for the production of 16mm prints from color negative using 35/32mm films.

film, personnel trained in handling 35mm film are used and much of the additional training that would be necessary for handling the more fragile 16mm film is avoided.

The 35/32mm films offer an advantage to the manufacturer in that normal 35mm width film may be perforated with 32mm perforations and special width slitting is not required.

Film Processing Sequence

Figure 2 is a block diagram of the various processing steps involved in the production of 16mm prints from black-and-white negatives by the 35/32mm method. As shown in the code, the solid black lines indicate where the image is in the 35mm size and the dashed lines indicate where the image is in the 16mm size.

The most common method of producing 16mm film by the 35/32mm method is shown on the lefthand side of the diagram where a 35mm fine-grain duplicating positive is made by contact printing from the original negative. From this positive an optical reduction dupe negative is made on 35/32mm film, with either a single image or a side-by-side double image. This dupe negative is then contact printed to 35/32mm positive, composite with the sound negative. The print is then slit to the two 16mm prints.

The processing sequence shown in the center of the diagram indicates where 35/32mm prints may be made by optical reduction direct from the 35mm negative. The sound is contact printed from the 35/32mm sound negative. As indicated on the right of the diagram, 35/32mm prints may also be made by contact printing from 16mm negative.

Figure 3 is a block diagram of the processing sequence for producing 16mm prints from color negative using 35/32mm films. On the left of the diagram is shown the processing sequence for producing black-and-white 16mm prints from the color negative, which differs from the similar sequence for black-and-white negative given in Fig. 2 only in that a panchromatic fine grain positive is required where color negatives are used.

16mm color prints are made in three ways, using 35/32mm film as shown in the central portion of Fig. 3. In one method registration separation positives are made from the color negative, and a registration 35/32mm reduction color internegative is made on 35/32mm Eastman Color Internegative Film, Type 5245. Contact points are then made on 35/32mm Eastman Color Print Film, Type 5382. The sound is printed from a 35/32mm sound negative. In the developing of this 35/32mm color positive, the sound area is separately coated and developed by a process described in an accompanying paper by Henry Goldfarb[5] of De Luxe Laboratories. Color prints on 16mm film can also be made on 35/32mm color positive by direct reduction from the original 35mm color negative as shown in the center of the diagram.

The other method at the left of the diagram shows a 35/32mm internegative made on Eastman Color Internegative Film, Type 5270, either by reduction printing from a 35mm color print or by contact printing from a 16mm Kodachrome print. A contact print is then made on 35/32mm color positive and slit to 16mm as indicated.

Printing

Reduction printing of picture dupe negatives on 35/32mm film stocks from 35mm material is done on an optical printer. The 35mm film passes through a conventional projection camera movement with the photographic image being optically reduced to a 16mm image. This image is exposed on the 35/32mm film passing through a special 35mm registration camera movement with 16mm registration pins and pulldown. These printers are equipped to handle 3000 ft of 35mm material and 1200 ft of 35/32mm raw stock. Such an optical printer is manufactured by Bell & Howell Co. and Producers Service Corp.

Reduction prints from 35mm negative direct to 35/32mm film may be made on an optical printer as described, but are

(This paper was received on October 25, 1956.)

positive.

Edge . . . . 0.060 in. Edge Distance. . . . . 0.036 in.

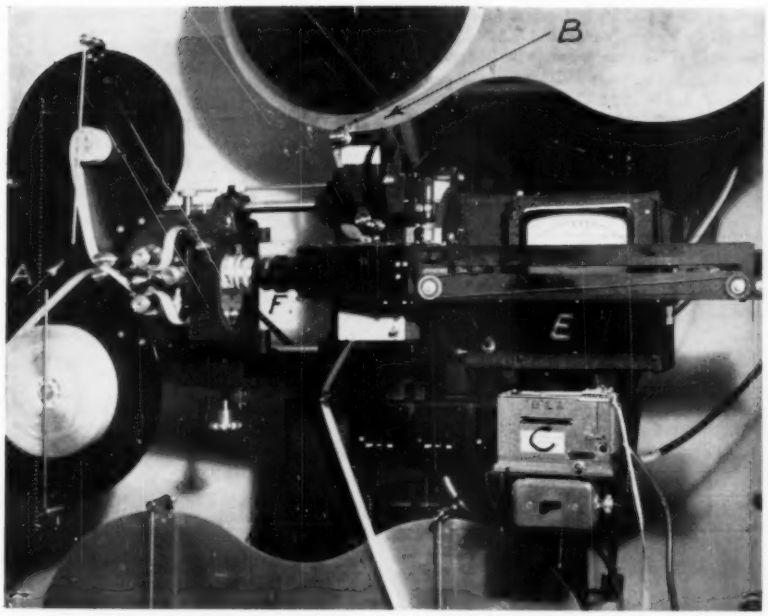

Fig. 4. A Depue Optical Reduction Printer rebuilt to handle 35/32mm color films.

A — Film path of 35/32mm raw stock being printed.
B — Film path of 35mm negative.
C — Punched-tape printer light control box.
D — Filter holder for color correction subtractive filters.
E — Lamphouse.
F — Reduction lens.

generally made on a reduction printer such as a Depue or a Peterson optical reduction printer modified for 35/32mm operation (Fig. 4). This printer differs in that it uses edge guiding and pull-down pins to achieve registration, instead of a registration pin. This type of printer movement is better adapted to the higher printing speeds necessary in making multiple prints.

Contact printing of 35/32mm film is accomplished on modified Bell & Howell Model D, Model J and Model E printers described in detail in an accompanying paper by Williams and Ford of Unicorn Engineering Corp.[4] When separate printing of sound negative is required, as with reduction printing, the 35/32mm sound is printed on a Model D printer, modified for high speed 35/32mm operation, with an efficient mechanical filter designed to minimize flutter in the sound prints. Printer light control is accomplished by punched tape which is described in a paper by Baumbach and Little.[5]

Where a small number of contact prints are required, a converted Model D or Model J printer is used, with suitable sprockets and guide rollers for 35/32mm operation (Fig. 5). Where multiple prints are required on black-and-white or color film, a Model E printer converted for 35/32mm operation is used. This printer is designed to print both picture and sound in one operation from 35/32-mm picture and sound negatives to 35/32mm print stocks.

Developing

The developing of all of the 35/32mm films is accomplished on normal non-sprocket-drive 35mm developing machines, along with other 35mm material. Where positive film is waxed or surface coated as a part of the developing process, the 35/32mm film and 35mm films are treated alike.

Inspection and Slitting

The 35/32mm prints are inspected on specially designed projection machines where the two side-by-side 16mm images are viewed on a small screen.

After inspection, the 35/32mm prints are slit on the precision slitter mentioned previously. The two 16mm prints are split out of the center and the 1½mm edges are cut off and discarded. The prints are then ready for final inspection and mounting for delivery.

Quality Control

Control tests are a very necessary part of a successful operation using 35/32mm films. Printers must be carefully checked photographically for alignment, focus, image placement, image size, printer light increment, printer gamma, and density. Sound is checked by flutter, high-frequency loss, intermodulation, cross modulation and listening tests. The slitting operation is checked several times daily by viewing samples of the slitting on an optical comparator for placement, weave and smoothness of edges.

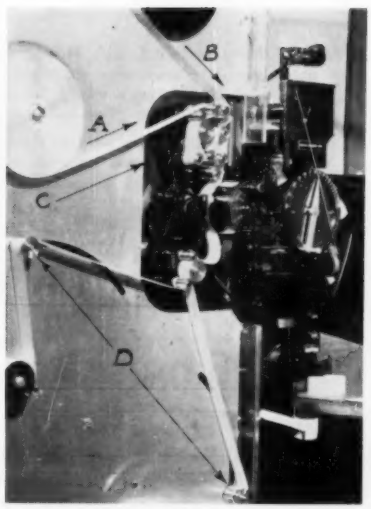

Fig. 5. Model D Bell & Howell Printer rebuilt to print 35/32mm or 16mm negatives to 35/32mm raw stock.

A — Film path of 35/32mm raw stock being printed.
B — Film path of 35/32mm negative.
C — Rollers and sprockets designed for 35/32mm or 16mm operation.
D — High-speed constant torque take-ups.

Conclusion

Statistics kept over a two-year period on the results of making 16mm prints on 16mm raw stock, compared with making 16mm prints on 35/32mm raw stock, in the same laboratory under similar conditions, show results favorable to the 35/32mm method:

(1) Number of prints rejected in inspection reduced by 50%;
(2) Lower processing costs; and
(3) Better sound frequency response by 1 to 2 db at 5000 cycles.

Considering these along with other advantages, a more extensive use of this method is predicted, particularly with the new color films coming into use.

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image is in the 35mm size and the

where 35/32mm prints may be made

an optical printer as described, but are

Discussion

Lewis Humphrey (Moody Institute of Science): Has there been any application of printing contact 16 to the 35/32 film, say in a Bell & Howell printer?

Mr. Gephart: Yes, some of the material shown in the demonstration film was done in this manner, such as where 16mm Kodachrome is printed A and B to 35/32mm, 5270 internegative. Model D, Model J and Model E Bell & Howell printers have all been remodeled to be capable of printing from 16mm to 35/32mm.

George Lewin (Army Pictorial Center): Can you tell us the speed at which you operate the special 32mm projector for inspection?

Mr. Gephart: The 35/32mm projectors are run at 108 feet per minute. For some purposes, inspection is done at normal speed after being slit to 16mm width.

Mr. Lewin: Would you care to tell us what percentage of the release prints you actually inspect by projection?

Mr. Gephart: All the 35/32mm prints are inspected in this manner, with about every tenth print of a release order being inspected a second time after slitting, on a normal 16mm projector at normal sound speed.

Combination Printing of 35/32mm and 16mm Films

By C. J. WILLIAMS
and A. L. FORD, JR.

The problem of printing on 35/32mm films from 16mm negatives and the other combinations of these two film sizes in negative or positive position is discussed. Modifications of sprocket, aperture plate, roller, film feed and film take-up are described as those which permit single printing machines to accomplish any of the above operations.

TWO SEPARATE 16mm films are derived from the single strand of 35/32-mm film in the manner described in the preceding paper. Sprocket dimensions of the two film sizes are, of course, identical, while the sprocket-to-edge distance of the 35/32mm film is 0.060 in. greater than that of the 16mm film. It is this difference in edge distance that makes it so practical to construct printing equipment capable of handling the two film sizes simultaneously or in any combination.

Film handling rollers, for example, may be designed in step fashion whereby both films are properly guided by the same solid roller, a condition which cannot be met with 32mm films.

It is of the greatest importance that both the 35/32mm and the 16mm films be supported throughout the printing operation in such a manner that no possible abrasions will occur in either the picture or soundtrack areas of the 16mm product. The areas left for film support are discussed below for a number of practical printing operations.

Areas Available for Film Support

The overall widths of 35mm and 35/32mm films are the same, actually 35mm or 1.377 in.* The use of this same size has resulted in the simplification of printer conversions, as most 35mm film path elements may be utilized with little reworking. Figure 1A shows the physical relationship between 35, 35/32, and 16mm films. Two rolls of 16mm film are obtained by trimming 0.060 in. from each edge of the 35/32mm film and slitting along the center line.

Figure 1A also shows the relationship of the 16 and 35/32mm film areas utilized by projection and printing equipment. The desirable film support regions lie outside these areas, where abrasion by the supports does not affect the quality of the print.

Figure 1B shows the phantom profile of a 35mm roller which has been reworked to provide a safe means of support for any of the three film sizes.

The lands are lettered for ease in identification. 35mm or 35/32mm films are supported by the lands U and Z. The land Y may be raised to the same level as lands U and Z to provide center support for the 35/32mm film. 16mm film is supported on lands V, W and X. Successful support of 16mm film has been accomplished with lands V and X only; however, use of land W provides greater roller traction.

The roller shown in Figure 1B shows the film supported outside the printed area at lands U, V and Z, and inside the printed area at lands W, X and Y. Safe supports are provided at lands W, X and Y by using narrow lands located within the maximum and minimum tolerances of the soundtrack printed area.† A roller with type Z lands at each end will provide sufficient support for 35/32mm film.

Conversion of Bell & Howell Model D, J and E Printers

The following items need revision or replacement to convert the above-mentioned printers for 16 and 35/32mm combination printing.

Part Name	*D*	*J*	*E*
Feed and take-up hubs	√	√	√
Feed and take-up keeper arms	√	√	√
Guide rollers	√	√	√
Feed sprockets	√	√	√
Keeper rollers	√	√	
Interrupter rollers	√	√	
Interrupter	√	√	
Main printing sprocket	√	√	√
Aperture	√	√	√
Stripper plates	√	√	
Shut-off roller			√
Squeegee plates			√

The feed and take-up hubs must be capable of handling male or female, 16 or 35mm plastic film spools. Here a hub containing three keyways has been used successfully. One keyway accommodates the male spool, the other two contain spring-loaded locking bars pivoted at the flange ends. The bars are of two lengths, one accommodating a 16mm spool and the other a 35mm spool.

The next item to be considered is the keeper arm which swings over the outside edge of the film roll to the feed or take-up hub. The arm must be capable of holding either size of film roll on the hub. Two-position placement of the feed arm has been accomplished by using a spring-loaded ball in the bearing block capable of locking into one of two positioning races in the keeper arm shaft. Another solution to this problem has been the mounting of two properly spaced keeper arms on a single shaft, each arm operating independently.

Guide rollers are profiled as described in Figure 1B. The sprocket hold-down or keeper roller has the same land positions as the guide roller; but in its particular application, the lands are all at the same level. Outer lands are relieved locally to allow the roller to clear the sprocket teeth.

The interrupter roller is another special purpose roller. This roller is similar to a guide roller which has had the left end removed at a point 0.030

Presented on October 9, 1956, at the Society's Convention at Los Angeles by C. J. Williams and A. L. Ford, Jr., (who read the paper), Unicorn Engineering Corp., 1040 N. McCadden Pl., Hollywood 38.
(This paper was received on October 19, 1956.)

* American Standard Dimensions for 35mm Motion-Picture Positive Raw Stock, PH22.36-1954, *Jour. SMPTE, 62:* 395–396, May 1954.

† American Standard Photographic Sound Record on 16mm Prints, Z22.41-1956.

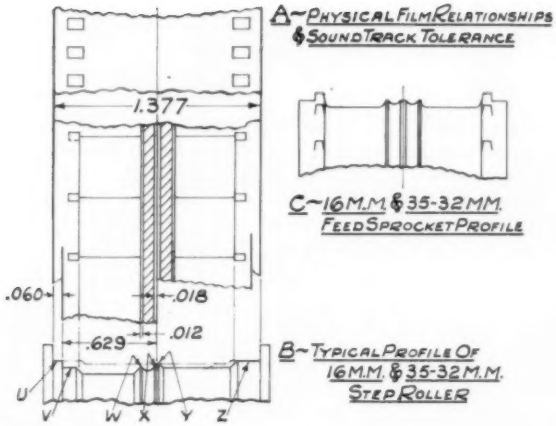

Fig. 1. Parts A, B and C.

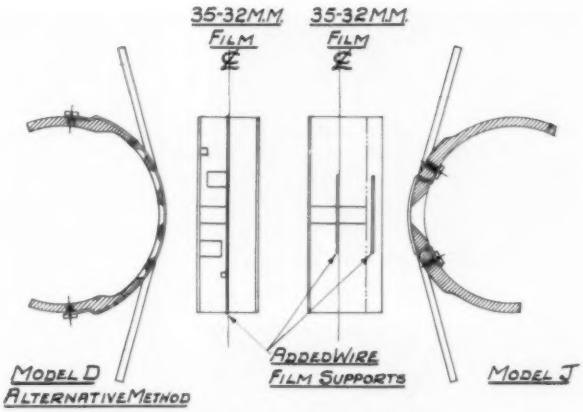

Fig. 2. Aperture rings for Bell & Howell Printers.

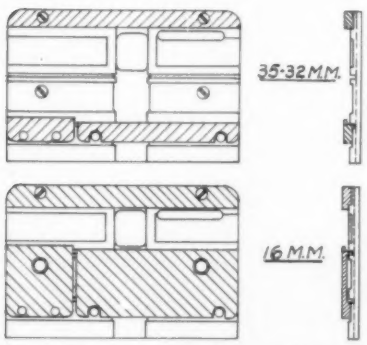

Fig. 3. Depue aperture plate, guide rail.

in. into land V (Fig. 1B). Lands Y and Z are at the same level. The lands V, W and X are stepped 0.037 in. below the level of lands Y and Z in order to accommodate the 16mm films.

The 35/32mm films rest on the lands Z and Y, then drop down to rest on land V. Overhang of the two films becomes therefore 0.030 in. and 0.090 in. The mounting of the interrupter contact roller and switch must provide a 0.060 in. adjustment in order to accommodate the different edge locations of the two film sizes. The entire interrupter and contact roller has been mounted by an overcenter spring which locks it into either position.

Sprocket Modification

The feed sprocket conversion of a Bell & Howell Model J printer has been accomplished by attaching a drum 0.689 in. long to the existing 20-tooth 16mm sprocket. A land, equivalent to land Z (Fig. 1B), is located at the outer end of the drum to support the 35/32mm film. Feed sprockets on the Model D printers have been replaced by two standard 16mm 20-tooth sprockets mounted back to back and doweled together. Special 35/32mm sprockets have been designed for use on the Model E printers. This sprocket must assemble in the same manner and fill the same space requirements as the existing 35mm sprocket.

Aperture Modifications

The Model J aperture requires very little alteration; however, it is necessary to provide some means of supporting either a 16 or 35/32mm negative. This has been accomplished by stretching two 0.010 in. diameter wires across the top of the aperture and securing them to the inner surface of the aperture ring with screws (Fig. 2). The outer surface of the aperture ring is grooved to receive the wires, and holes are provided on each side of the aperture opening for the wires to pass through the ring. The 16mm supporting wire is located 0.005 in. from center line toward the back of the machine, so that the film contact is in the same area as the land X shown in Fig. 1B. The 35/32-mm supporting wire is located in the area of the land Z just outside the 35/32mm film perforations.

It is easier to replace the Model D aperture and sprocket with the Model J kit than it is to rework the 35mm aperture ring.

The outer surface of each stripper plate on both the Model J and Model D printers must be relieved to furnish lands similar to the sprocket lands of Fig. 1C. The end of each stripper plate nearest the aperture requires notching to provide clearance for the added support wires.

The aperture plates of both the sound and picture printing heads on the Model E machine must be replaced with new 35/32mm plates. These plates have been designed to fit the new sprockets without reworking the printing heads. It is necessary, however, to open up the inside edges of the ring lying within the picture sprocket. Slots 0.021 in. deep, slightly wider than the aperture opening, are provided to allow light passage from perforation to perforation, since this distance is greater than that involved with 35mm film.

Other units requiring consideration in the conversion of the Model E machines are the air cleaning unit, the shut-off rollers, the film take-up and the matte.

Conversion of the Depue Optical Reduction Printer

The conversion of the positive film path on the Depue Optical Reduction Printer involved the same basic principles as outlined above. The feed and take-up hubs were made capable of mounting either 16 or 35/32mm film spools. The feed and take-up keeper rollers and feed sprockets were modified along the lines previously described.

A special adjustable aperture plate has been designed to handle either 16mm or 35/32mm films on the Depue printer.

A new aperture base plate contains a dovetailed slot for the aperture slide. The base plate is relieved to provide mounting surfaces for the guide rails and to provide film support at the aperture. The new base plate is interchangeable with the single purpose plate.

The top view of Fig. 3 shows this new plate with the 35/32mm guide rails and escape plate in position. For 16mm use, these rails and the escape plate are replaced with larger units as shown in the lower view of Fig. 3.

Combination 16 and 35/32mm Depue Optical Reduction Printers, equipped with this new aperture assembly, are now available from the manufacturer.

Conclusion

The printer conversions described in this paper have worked out very successfully in production use. While details have been given only for specific types of printing equipment, dimensional information and basic principles may be applied readily to machines of other manufacturers.

The multipurpose machines herein described are exceedingly versatile in their handling of either size of films in positive or negative positions. A minimum of machine adjustment is involved with a film size change.

1954, *Jour. SMPTE, 62:* 395–396, May 1954.

ord on 16mm Prints, Z22.41-1956.

the left end removed at a point 0.030

The Slitting of 35/32mm Films

By C. J. WILLIAMS
and H. L. BAUMBACH

The problem of precision slitting of a strand of 35/32mm film into two 16mm films is discussed. The machines which were designed and constructed for this purpose are described in detail. These machines are fully automatic in operation and incorporate gauging devices, micrometer adjustments and safety features. Measurement of the slit films on an optical comparator and quality control procedures are described.

The introduction of motion-picture films 35mm wide and carrying 32mm perforations is described by W. E. Gephart in an associated paper (see earlier pages of this issue of the *Journal*). Since the ultimate purpose of these films was the production of a 32mm print from a 35/32mm negative, standards were prepared only for its negative use. American Standard PH22.73-1951 describes the specifications for the cutting and perforating of 35/32mm for negative raw stock. American Standard Z22.71-1950 describes the similar specifications of 32mm film for both negative and positive films. In the latter standard, positive film width is made 0.001 in. less than the width of the negative.

Proper slitting of 35/32mm positive films has required the same reduction in 32mm width explained in Z22.71-1950 for positive, with the exception that the reduction must be applied to dimension I rather than A because of the loss of all original film edges after the slitting operation is complete.

Splendid cooperation from film manufacturers has resulted in the production of positive 35/32mm films ideally suited to the slitting requirements.

Producing proper 16mm prints to conform to American Standard PH22.12-1953 requires correct dimensioning of the 35/32mm source material and the precision slitting of the film itself. Since both original edges of the 35/32mm film are cut away and an additional center cut is made, two dimensions of the 16mm film become of importance to control in the slitting operation. These are the values of A and E, which constitute the overall width and the "perforation to edge" distance, respectively, of the 16mm films. All other dimensions are derived from those previously present in the manufactured product.

Experimental Investigations

The advantages of using 35/32mm films for the production of 16mm prints were so interesting to General Film Laboratories that the authors undertook an extensive research and development project with the aim of solving the problems involved in the slitting of this film. In this matter, the American film manufacturers were most helpful. Ansco, the Du Pont Company and the Eastman Kodak Company each provided extensive and valuable consultation and information.

The slitting of 35/32mm film presents a problem somewhat different from the cutting of multiple strands from a broad sheet, since the cuts themselves are not equally spaced with respect to material width. Experiments led to the conclusion that the attempt should not be made to perform all three cutting operations simultaneously. Symmetrical cutting gave the best results. For this reason, it was decided to perform the slitting in two stages, the first involving the two edges of equal widths and the second the center where film widths are likewise equal.

There also proved to be decided advantages to the guiding of the 35/32mm film from the perforations, rather than the edges, since this is the manner in which the images are printed. This procedure results in projected 16mm images of improved steadiness by virtue of error cancellation.

The film manufacturers strongly recommended that the cutting knives be mounted with unusual rigidity and our own tests substantiated the recommendation.

It then became apparent that it was essential to be able to position the knife blades with great accuracy and to be able to make minute corrections in blade positions with corresponding accuracy. Micrometer positioning of the blades was therefore necessary.

The requirement of knife blade positioning presented a serious problem since normal slitting practice involves the physical contact of the knife with another metal surface. Usually the knife overlaps a land area and is spring-loaded against it. The problem of separately controllable land positions upon the sprocket supporting the film appeared very great and, moreover, considerable wear would be expected to occur at the points of knife contact.

Tests determined that a smooth cut could be made upon the film by a hollow-ground slitting knife without physical contact between the knife and the land, provided the distance from knife to the land supporting the film was small in comparison with the film thickness.

It was then decided that the sprocket lands would be fixed in position and have values which would permit a ± 0.0005 in. range for knife positioning.

It was also decided to include a device within the machine capable of gauging the accuracy of the slitting width of both strands and to make the machine inoperative if American Standards were not met.

It was quite obvious that in order to maintain tolerances of ± 0.001 in. in the slit films it would be necessary to build the slitting equipment to an even greater degree of accuracy. All film supporting and cutting surfaces and film alignment devices would therefore need to be held to values accurate to ± 0.0002 in. or better, in order not to build up accumulated errors.

Description of the Machine

The machine is shown in its final form in Fig. 1. The base and front panel are constructed of one-inch aluminum jig plate in order to maintain an accurate surface and minimum warp.

The 35/32mm film roll mounts on the tension spindle below the machine. Unwinding film passes over the electrically sensed run-out roller, then a thickness gauge (to detect staples or paper clips), thence into a normal positive pitched sprocket and keeper assembly. Between the feed sprocket and the supplementary sprocket at the left of the machine, the film is tensioned on both sides of the large cutting sprocket. Two knives trim the two film edges at the bottom of this cutting sprocket and small tubes carry the 0.060-in. edges downward into a basket. The film is now 32mm wide as it passes over the supplementary sprocket and returns tensioned to the top of the cutting sprocket. The third knife slits the 32mm film into two 16mm films at this point.

The two 16mm films are then separated and passed through separate gauge rollers and over the take-off sprocket and thence to torque-motor-operated reel spindles.

Series electrical motors and a thermal delay relay cause the machine to start slowly. After several seconds the machine reaches its normal operating speed of approximately 400 ft/min.

Eight electrical safety devices on the machine bring about a rapidly braked halt in machine operation. Excepting for the first two devices, the machine cannot be restarted by the operator unless the difficulty is corrected.

Presented on October 9, 1956 by C. J. Williams (who read the paper) and H. L. Baumbach, Unicorn Engineering Corp., 1040 N. McCadden Pl., Hollywood 38.
(This paper was received on October 19, 1956.)

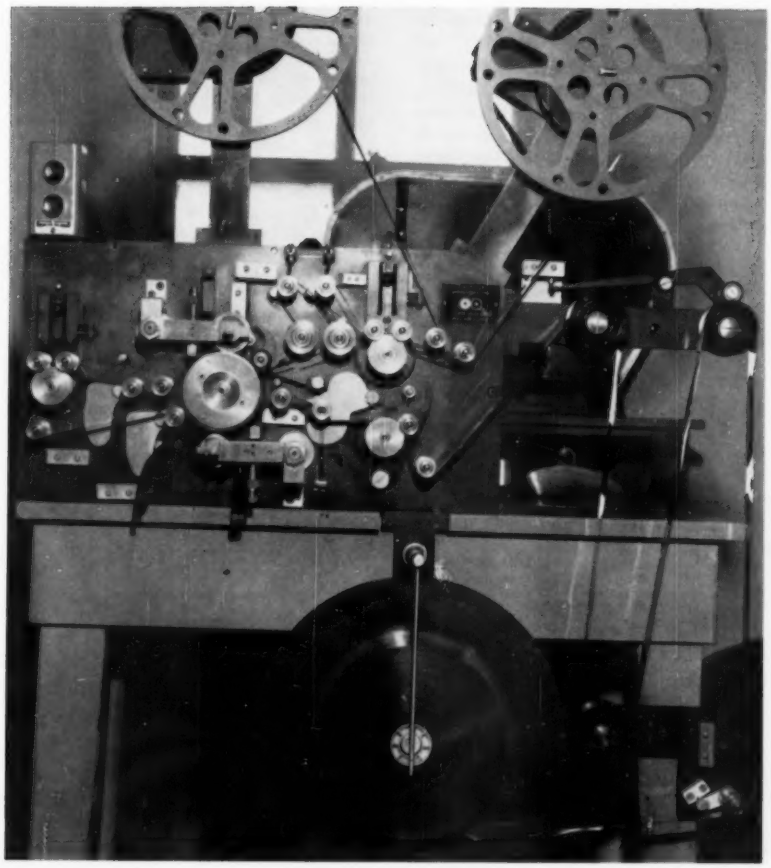

Fig. 1. The complete slitting machine.

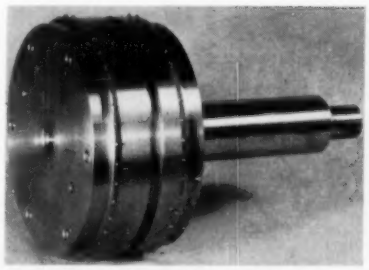

Fig. 2. The main cutting sprocket.

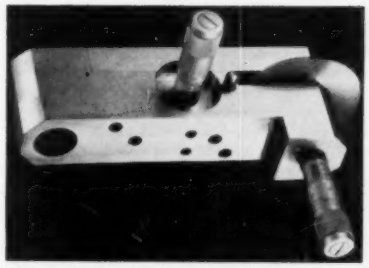

Fig. 3. Cutting knife and holder.

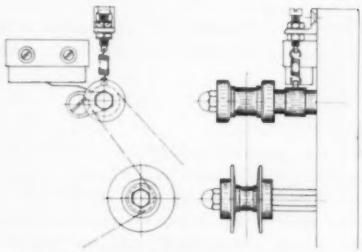

Fig. 4. Gauge roller assembly.

The first safety device stops the machine when the film is used up on the feed spool. The second acts when thickness is excessive. Third, fourth and fifth render the machine inoperable when tensions are not proper on the main cutting sprocket. The sixth insures that the two cut 16mm films are held snugly against the sprocket at the point of center cutting. The seventh and eighth devices gauge the 16mm widths (A dimensions) and stop the machine operation if these are incorrect.

In order to avoid rethreading the machine for each new roll of 35/32mm film, rolls are joined together with cement splices and fed into the machine on a stop-and-go basis.

The Main Cutting Sprocket

This sprocket is shown in Fig. 2. It will be noted that two rows of sprocket teeth position the film in a manner very similar to that used in film-printing machines. In one of the rows the sprocket teeth are full-fitting with respect to film perforations. This sprocket is laminated in order that hardened steel film support surfaces are adjacent to each of the cutting knives. It is apparent that the seven pieces of this sprocket must be machined with extraordinary care, to specifications, permitting fabrication only in the finest of precision shops. The Mitchell Camera Co. has successfully produced a number of the cutting sprockets. Because the knives do not actually touch any of the lands of the sprocket, its useful life has not yet been exceeded in operation.

The cutting sprocket is mounted in a massive housing, fitted with Barden Precision Bearings.

The Cutting Knives and Housings

As illustrated in Fig. 3, the cutting knives are held in a massive housing which permits two-dimensional positioning by means of micrometer screws. The knives are constructed of Ketos steel, hardened to a Rockwell hardness of 62–63. Knives are ground with a relief of 1°. A 45° hollow grind completes the cutting surface. Knife-bearing surfaces are precision ground to fit snugly into Oilite bushings held within the type 303 stainless-steel housing.

The useful life of each knife before resharpening is required is somewhat variable but is usually about 2,000,000 ft of slit film.

The Gauge Rollers

A film width measuring roller is provided to gauge each of the 16mm slit films. As illustrated in Fig. 4, film which is being slit oversized will be forced to occupy a larger radius within this spool, thereby tightening the loop it makes with the associated upper roller and shutting off the machine. Any serious error in the position of the center cutting knife will result in one of the 16mm films having an improper A dimension, thereby not permitting operation of the machine. Such a difficulty must be corrected by a mechanic before slitting may be continued.

Results of Production Use

Two of the machines described in this paper have been in production use at General Film Laboratories for over two years. More than 100,000,000 ft of 16mm film has been prepared on them and all of this length gauged for maximum width.

Because of the great precision required in the slitting operation, preventive maintenance schedules have been maintained from the inception and any lessening of accuracy or performance has quickly been corrected.

Massiveness of mountings is sufficient to permit extensive slitting without adjustment, sometimes exceeding a million feet, but careful checks are made upon slitting accuracy.

While the gauge rollers built into the machine will detect weave or errors in the A dimension, measurement of the E dimension requires the use of an optical comparator. Samples of slit films are checked several times a day on the comparator for weave and size of both E and A dimensions. A Bausch & Lomb, Type 33 12-11 Optical Comparator equipped with a micrometer stage graduated in 0.0001 increments is used for film measurements.

Because of the precision built into the machine, no difficulty is experienced in keeping well within American Standards for the 16mm product. Weave in the E dimension is kept better than ±0.0004 inch, and the A dimension better than ±0.0006 inch, with average E values of ±0.0002 and A values of ±0.0004.

Acknowledgments

The authors must express their appreciation to the numerous individuals connected with the film manufacturers for valuable assistance and suggestions during the planning stages, in particular, G. C. Misener and W. C. Hasenbalg of Ansco; H. W. Moyse, H. T. Harding and L. V. Reynolds of Du Pont; and R. M. Corbin and A. C. Robertson of Eastman Kodak.

Sound Developer Application to 35/32mm Soundtracks on Eastman Color Print Film

By HENRY GOLDFARB

This paper describes the application of sound developer to a soundtrack down the center of the film by means of an applicator wheel.

In the standard method for edge sound application on Eastman 5382 color positive the film goes through the regular color developing solutions and is then passed over a very highly polished wheel called a film guide drum, then a smaller wheel, or application drum, picks up the soundtrack developing solution and applies it to the edge of the 35mm film. By applying a jet of water away from the picture area against the applicated soundtrack, the sound solution is washed off toward the perforations. By doing this the sound developer does not come in contact with the picture area.

The development 35/32mm color positive film is not so uncomplicated. The purpose of 35/32 film is to make it possible to print two 16mm pictures on one strip of positive with both soundtracks down the center. After developing, the positive is slit into two 16mm prints:

The sound applicating formula follows:

Sound-Track Developer (Kodak SK-32)

Solution A	*Metric*
Water	600 ml
Kodak Sodium Sulfite, desiccated	40 grams
Kodak Elon Developing Agent*	40 grams
Kodak Sodium Hydroxide (caustic soda) while cooling, add with stirring	80 grams
Kodak Hydroquinone, dissolve completely	40 grams
Solution B	*Metric*
Gum tragacanth (industrial grade)	5.0 grams
Place in a thoroughly dry, clean, one-liter beaker, then add:	
Alcohol (3A Specially Denatured)	10.0 ml
Swirl in the beaker until the mixture is distributed over the bottom and on the sides of the beaker to about one-third its height	
Add:	
Water, about 70 F (21C)	300 ml
Sodium hydrosulfite	60 grams

Although this is essentially the formula recommended by Eastman Kodak Co.,

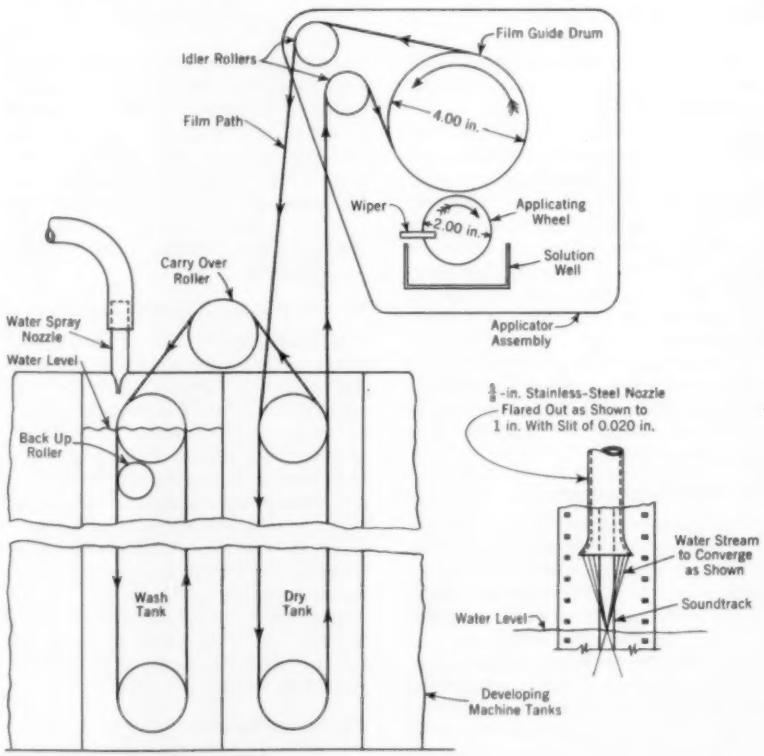

Fig. 1. Schematic of 35/32mm soundtrack application.

Presented on October 9, 1956, at the Society's Convention at Los Angeles by Henry Goldfarb, DeLuxe Laboratories, Inc., 1418 North Western Ave., Los Angeles 27.
(This paper was received on January 18, 1957.)

* The Elon will not dissolve completely until the sodium hydroxide has been added.

it should be noted that the ethylenediamine has been eliminated. It is in the original formula for the purpose of helping speed up the sound developer. Before we discontinued using this chemical we were getting spots in the picture area. Tests showed that the sound developer minus the ethylenediamine gave excellent results and the spots were eliminated.

The applicating drum is placed so it applies the sound solution in the center of the positive film instead of on the edge as in the conventional method of edge soundtrack development.

Because the different batches of gum tragacanth vary in consistency, it was found necessary to vary sometimes the amounts of gum tragacanth and alcohol.

The applicator now in use for 35/32-mm sound application is one of the first types recommended by Eastman Kodak. Some minor alterations have been made such as giving a concave applicating surface with a 3-in. radius to the applicating drum. The applicating wheel travels in the same direction as the film with the speed a one-to-one ratio. For a soundtrack application of 210-mil width a wheel of 176-mil width is used. The distance of the applicator wheel to the film is normally about 0.012 in. but the distance must be varied should there be a change in the viscosity of the sound developer.

The chief problem was to find a method of washing off the surplus sound developer from the applicated soundtrack which is in the center of the 35/32mm positive without causing bleeding and splashing in the picture area. That was accomplished by changing the amount of pressure on the water spray and changing the opening of the water nozzle. It was found that the opening shown in the drawing (Fig. 1) was most effective and hundreds of thousands of feet of 35/32mm film have been processed in this manner with complete satisfaction. Figure 1 also shows the size of the film guide drum and applicating wheel used. The most important step of the process is to spray a fast jet of water on the film just before the positive goes into the wash tank. This causes a strong turbulence in the wash tank which prevents the sound solution from lying around the film.

In Fig. 1 beneath the water spray nozzle are two rollers, the smaller of which is of special interest. It is for the purpose of keeping the film in a straight line with the spray; otherwise the film has a tendency to move under the roller and out of the line of the spray.

Discussion

Lewis Humphrey (Moody Institute of Science): In the washing off of the soundtrack developer which is now in the center of the film — is that washed across the film or in a direction with the film?

Mr. Goldfarb: Horizontally with the film; in the same direction as the film travels. I might add that we found out that the width of the spray is not important. We had it a quarter-inch wide, a half-inch wide, and it made no difference. The force of the spray and the turbulence of the wash water must be great enough so that the sound solution doesn't lie around the film when the film goes into the wash tank.

Lubrication of Release Prints With Silicone

By HARRY BRUEGGEMANN

Paraffin is commonly used as a film lubricant. It is applied to the film in solution, the solvent being either toxic, inflammable or expensive, and it has a tendency to cause streaks on the film. A new silicone of the nonfogging variety can be applied to the film in a water suspension just before the film enters the drying cabinet. This system eliminates the disadvantages of paraffin and also gives better lubrication. This paper describes in a qualitative way the development of the production procedures for this system.

Motion-picture film running through a projector requires lubrication, since bare photographic emulsion rubbing against the film gate results in friction. This friction is great enough to cause particles of the emulsion to adhere to the film gate, and these particles form a nucleus for further friction and more emulsion deposit. After a short time these particles grow to a size large enough to begin tearing off shreds of the film, jamming the film gate and damaging the film. In other words, once friction starts, a vicious circle of friction to particle deposit to friction is built up, which does not stop until the projector is shut down. Paraffin has been the commonly used lubricant, but it is difficult to apply in a uniform coat, and must be kept out of the picture and track area because it produces streaks. Since a good lubricant has been difficult to obtain, there have been many special formulas and additives used at various times, with varying success.

Because of this unsatisfactory situation, we at Pathé Laboratories have been on the alert for any new developments in the art of film lubrication. About a year and a half ago, Dr. Herbert Meyer of the Motion Picture Research Council advised us that there was a new silicone on the market, one which had properties that might make it a good film lubricant. It was nonfogging, and could be applied to the film by means of water suspension. We ran some hand tests on short footages; the results were promising enough to prompt us to try it out on production.

First, of course, we ran fogging tests. The secondary contact tests, that is — vapor contact and contact of the emulsion to material which had contacted the silicone — were entirely negative. The primary contact tests, in which the silicone was placed directly on the emulsion before processing, were negative on black-and-white positive, and questionable on color positive stock. This questionable fogging on direct contact ruled out the use of the silicone on negative which contacts positive raw stock during printing, at least until more thorough tests can be made. Negative, however, is not usually lubricated. It is the positive which requires lubrication before projection.

There was also the possibility that the silicone may have adverse effects on the processing solutions or on the aging characteristics of the film. We did not run exhaustive tests along these lines, but in the course of our work we found that the silicone was relatively inert chemically and photographically. Thus it was considered safe to use the silicone in the laboratory, providing it was not allowed to come in contact with unprocessed raw stock.

Pilot-Production Test

The silicone which we use is Dow Corning 35B, but we understand that Union Carbide Silicone LE-45 and General Electric Silicone SM-61 are equivalent. It is best applied to the film by means of a short dip into the water suspension just before the film enters the drybox. The normal processing procedure for Eastmancolor positive already has a short dip formalin bath just before the drybox, so in this case it was simply a matter of adding the silicone to the formalin. A pilot-production test was designed, whereby at the end of the working day the standard formalin was drained from the dip tank, which was then filled with the special formalin plus silicone. Our initial composition was 0.2% silicone added to the formalin. Only mild mixing was required since the silicone is self-dispersing. A 1000-ft roll of color positive was run through the processing machine and then repeatedly projected.

It was immediately evident that this lubrication method was superior to any heretofore tried. The emulsion surface had a uniform streak-free coating of lubricant; there was a reduction in chatter as the film went through the projection gate; there was no tendency for the emulsion to adhere to the gate; and much to the amazement of the projectionist, the dust which usually accumulates in the gate during a screening of this sort was greatly reduced.

In subsequent tests, by increasing the concentration of silicone in the formalin we were able to reduce chatter and dust even more. The proportion which was finally attained is 1%. This was considered by Dr. Meyer to be rather high, apparently due to the air squeegee through which the film passes immediately after the dip tank. At Pathé we use a suction squeegee to remove excess moisture from the film before it enters the drybox, instead of the more common pressure air blowoff. This squeegee also removed a large quantity of the silicone, requiring a high concentration to get a good coating on the film. After the tests were completed, we went into full production with silicone on color film, and for the past year all color prints from Pathé have had silicone lubrication.

Use on 16mm

Our attention next turned to 16mm black-and-white prints; 16mm had always been more of a problem than 35mm. Only one edge of 16mm can be lubricated with paraffin, since wax on the soundtrack side causes noise and volume level changes. This leaves the soundtrack side susceptible to gate friction and damage. Furthermore, many 16mm projectors operate with high gate pressure, compounding the difficulties. In order to get the silicone onto the black-and-white film a dip tank was installed just after the final wash. This system is shown in Fig. 1.

To prevent dilution of the silicone suspension, excess water from the final wash is removed from the film by a pressure blowoff just before it enters the dip tank. To conserve the silicone, the excess is blown off the film back into the dip tank by a second blowoff just after the dip. The film then travels through the normal suction squeegee and into the drybox. The level in the dip tank is maintained by a float, which operates a low-voltage switch, which in turn operates a solenoid valve that controls the flow of silicone from the boost tank. The boost tank is on the floor above the process machine, thus the silicone is gravity fed to the dip tank. The silicone has a tendency to settle out of suspension in the boost tank, where it remains undisturbed for several days after being made up by the chemist. To eliminate this, a mixing motor was installed, which is controlled by a timer. Every half hour

Presented on October 9, 1956, at the Society's Convention at Los Angeles by Harry Brueggemann, Pathé Laboratories, Inc., 6823 Santa Monica Blvd., Los Angeles 38.
(This paper was received on September 6, 1956.)

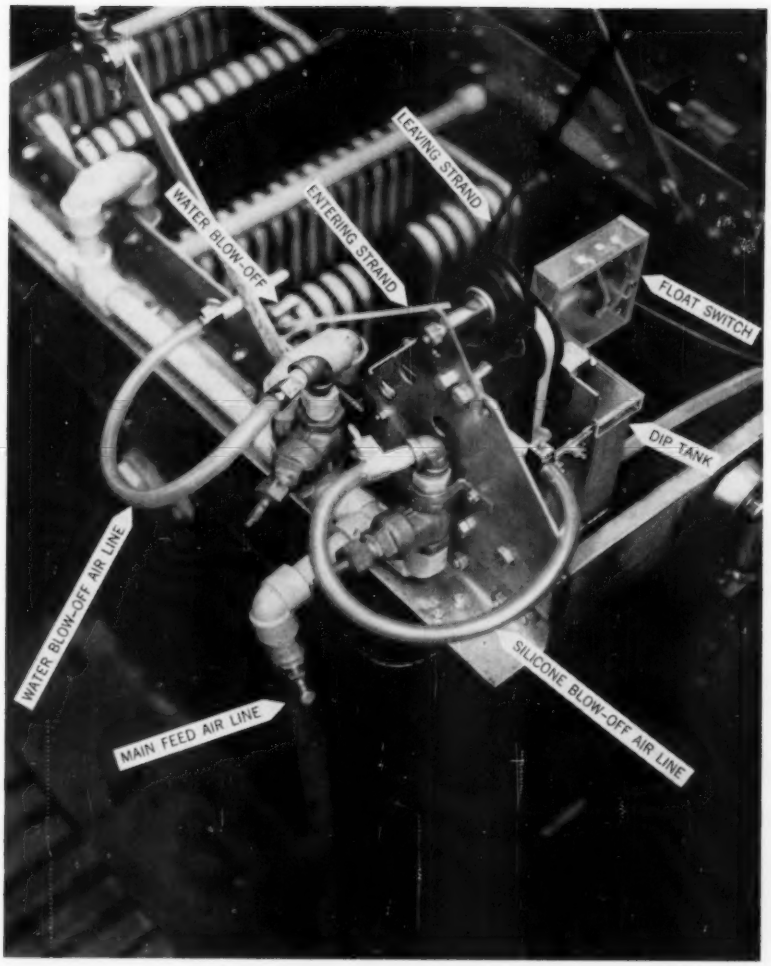

Fig. 1. Silicone dip tank as installed on a 16mm black-and-white process machine. The float switch is enclosed in the plastic box above and to the right of the dip tank, as a protection against moisture. The two hoses are the air lines for the pressure blowoffs ahead of, and behind, the dip tank; they are fed by the large hose coming up through the floor.

the mixing motor is turned on for 30 sec, and this gives sufficient agitation to maintain the suspension.

Since this system has been in operation, our 16mm film lubrication problem has been virtually eliminated. We are now installing silicone tanks on all of our positive process machines, and shortly all prints from Pathé Laboratories will be silicone lubricated.

There is another advantage to this system. Since it is part of the process machine, it eliminates waxing as an extra operation, saving labor and reducing handling time. However, there is also a difficulty involved, which is a result of the butter-like consistency that the suspension acquires when the water is mostly removed. This causes trouble in the squeegee evacuation system suction lines, the compressor and the compressor muffler, wherever the air velocity in the system drops to the point that the silicone has time to settle out of suspension.

The situation is not much better where pressure blowoffs are involved, because everything within several feet of the blowoff acquires a slippery coating after a short time. Our defense has been to put silicone traps in the suction lines, use the straight-through type of muffler instead of the packing type, and to bury the silicone blowoffs deep in the dip tank. A silicone trap is a box of large cross-sectional area, which reduces the air velocity and allows most of the silicone to settle out. Putting the blowoffs deep in the dip tank prevents much of the side splatter. We still must flush and brush the suction lines weekly and wash down the areas around the blowoffs daily. But everything considered, this is a small price to pay for the advantages of silicone lubrication.

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4. R. H. Talbot, "Lubrication of 16mm film," *Jour. SMPE, 53:* 285–293, Sept. 1949.

Discussion

Wadsworth E. Pohl (Technicolor Corp.): Does this type of lubrication have to be removed before film can be magnetically striped for Cinema-Scope-type sound work?

Mr. Brueggemann: We don't know because we have not had occasion to use it in connection with magnetically striped material. However, we did find out that it affects the chemical etching process that is used by the Titra Company in New York. They have difficulty in going through the silicone and making their titles, but I don't know about the magnetic striping.

W. E. Gephart, Jr. (Session Chairman): We have had difficulty in magnetic striping at General Film Laboratories, where we have attempted to stripe silicone-coated film. The magnetic strip does not adhere well unless the silicone coating is removed. Silicone coatings are very difficult, if not impossible, to remove, so I think you would have serious problems magnetic-striping over a silicone coating.

Mr. Brueggemann: The only defense against that would be to withhold from the silicone waxing process any prints that are to be Cinema-Scope-striped.

Herbert Meyer (Motion Picture Research Council): The furniture trade has experienced similar difficulties with silicones. Silicones are used as effective ingredients in furniture polishing formulations and the difficulty is the same: namely, furniture polished with such compounds is difficult to relacquer because the lacquer will not adhere satisfactorily to the polished surfaces. A surprisingly simple way has been found to eliminate this difficulty which consists of merely incorporating a trace of the same silicone in the lacquer. This will unfailingly make both lacquer and polish compatible so that the lacquer coating will adhere perfectly to the polished furniture surfaces. This same procedure might prove applicable also to magnetic striping.

Mr. Brueggemann: Thank you very much, Dr. Meyer. We shall try that when we run into that problem.

Jack P. Hall (General Film Labs. Corp.): Has any attempt been made to try this out in the conventional types of motion-picture film lacquers?

Dr. Meyer: I have no information in answer to this question. It may be mentioned here that silicone as a film lubricant was first employed in a solvent-base system and not in a water-base system (emulsion). The results of these earlier applications were, we understand, not too satisfactory.

A Dustograph

By CHARLES A. MORRISON

A portable instrument for the rapid, volumetric determination and recording of the less than 1- to over 100-micron particle content in atmospheres is described. Dust is collected by impingement on a moving ribbon of acetate film. Optical density is measured at the site of deposition on the ribbon and recorded. Constancy of air flow and positioning of the ribbon with respect to the orifice are controlled by the application of aerodynamical principles. Provision is made for the visual viewing of the deposit under the orifice. Ribbon speed is controllable to allow for wide ranges of dust concentration.

The rapid, volumetric determination and recording of the dust content in the atmosphere are of increasing importance in industrial and civic operations. A device (Fig. 1), which meets many of the essential requirements in these fields, including rapid speed of response, visibility of the dust as it is deposited, and portability, has been constructed. The construction is partly based on principles previously adopted by Hazard[1] and by Simmons and Robertson.[2]

As shown in Fig. 2, a 35mm ribbon of thin acetate film (F) is driven by a synchronous motor with a variable-gear reduction (R) past an orifice (O) at rates which are adjustable from 0.25 to 6 in./hr. A vacuum of about 20 in. of mercury maintained in the chamber (C) by a pump connected to an outlet (V) causes air to flow through the intake (I) and then through the 0.007- × 0.042-in. orifice (O) at sonic speed to impinge on the film. If the air is not completely dry, the rapid expansion of the air after passage through the orifice causes each particle of dust to become the nucleus of a condensed water droplet which aids the adhesion of the particle to the film during mechanical impingement. The film, governed by the Bernoulli effect, automatically assumes a fixed position from the orifice, and the volume of air passing through the orifice per unit time is constant, provided that the difference in pressure between the two sides of the orifice is greater than 0.53 atmosphere.

The axis of the orifice lies in the axis of the optical system which projects an image of the exciter-lamp filament (S) on the plane of the orifice. This image is projected by an 8mm microscope objective (L) and a mirror (M) to a phototube (T) which feeds an amplifier and a recorder with a signal which is correlated with the optical density of the dust deposited on the film. A beamsplitting element (P) permits the deposition of dust to be viewed continuously through an eyepiece (E), if desired, while the recording is made. Figure 3 shows a specimen of dust deposited on the film and the corresponding graphic record.

The instrument may be used directly at the site of operations, with the intake nozzle on the top of the case or with a hose connected to reach the desired point of observation. The response time is usually less than a second without a hose, and increases about 2.5 sec for each 10 ft of $\frac{5}{16}$-in. internal-diameter hose. The selection of film speed permits the use of the instrument through wide ranges in the level of dust concentration. The slowest speed is suitable for situations which are considered to be extremely free of dust and the fastest will take care of high industrial dust levels.

Communication No. 1858 from the Kodak Research Laboratories, submitted as a contribution on January 4, 1957, by Charles A. Morrison, Research Laboratories, Eastman Kodak Co., Rochester 4, N.Y.

References

1. W. C. Hazard, "An atmospheric dust recorder," *Jour. Franklin Inst., 217:* 571, 1934.
2. N. L. Simmons and A. C. Robertson, "The measurement and control of dirt in motion picture processing laboratories," *Jour. SMPE, 46:* 185–205, Mar. 1946.

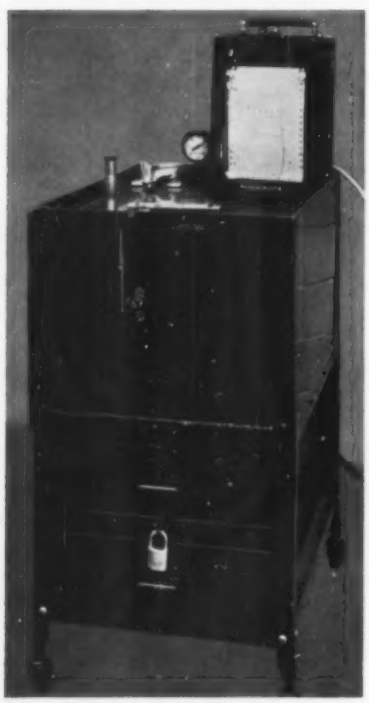

Fig. 1. Front view of the Dustograph.

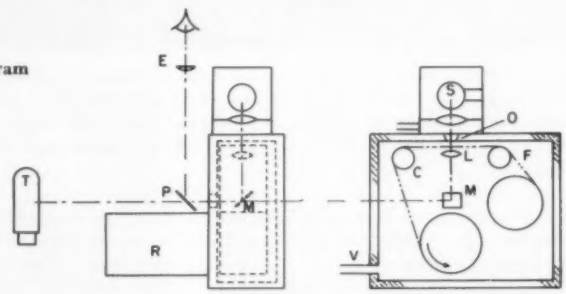

Fig. 2. Schematic diagram of the device.

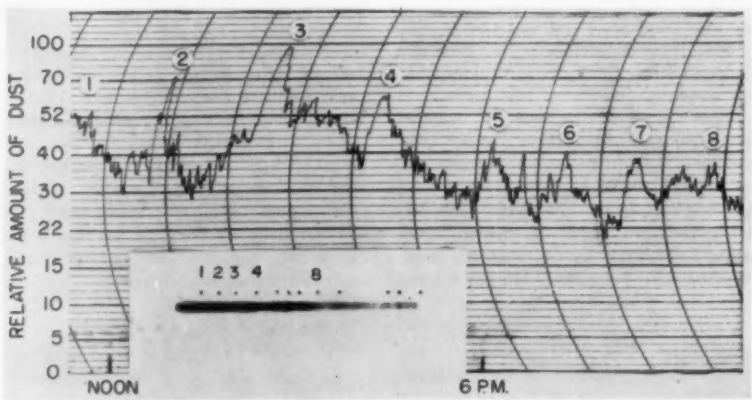

Fig. 3. Deposited dust on film and corresponding recorder trace.

Internally Directed Air to Improve Contact and Negative Life in Continuous Motion-Picture Printers

By HOWARD F. OTT
and ROBERT C. LOVICK

Methods of using air pressure to improve film-to-film contact in continuous motion-picture printers are reviewed and compared to ordinary mechanical pressure methods. Advantages of internally directed air are cited and are supported by numerical test data to show improved definition due to better contact and greatly extended negative life. Modifications to equip two production model printers (Bell & Howell Models J and D) with internal air jets are described.

In the past many methods have been used to improve contact in continuous motion-picture printers. It is well known that improved contact is apparent in the form of better picture definition. It is also well known that the frequency response of the sound record is improved by better contact.

This paper is intended as a report of the results of installing internal air jets in Bell & Howell Printers, Models D and J.

Obtaining Contact

The best contact that can readily be obtained between two photographic films is produced by means of a vacuum printing-frame. A vacuum frame exhausts the air from the space between the two films, and also from the space between the frame and a transparent covering film, allowing atmospheric pressure to force the two films into contact. Prints made in a vacuum printing-frame are useful for determining printing aims. Although the system can easily be applied to step printers, we know of no practical way of applying vacuum techniques to continuous motion-picture printers.

Several methods employed to obtain or improve the contact of the films in motion-picture printers are:

(1) Backing shoes;
(2) Roller gates;
(3) External air jets;
(4) Internal compressed air;
(5) Internal air jets.

The backing shoe, lightly contacting the base of the raw stock, is probably most widely used as a means of holding the raw stock close to the negative. Roller gates were developed in an effort to obtain better contact by localizing the pressure to one or two areas near the aperture. Another logical development was the application of air by jets directed against the base side of the raw stock. This method provides good contact — nearly equal to that obtained with a vacuum frame.

However, all of the preceding methods have an important common fault. Pressure exerted on the base of the raw stock can force the negative against the fixed printing aperture. If this happens as the films move through the printer, base scratching of the negative is inevitable. Thus, attempts at contact improvement by these methods can increase wear on the negative, while the wear on the print stock is decreased. Figure 1, purposely exaggerated, illustrates how external air jets can force the negative against and into the printing aperture.

Contact is important but should not be obtained in a manner that increases the possibility of damage to the negative. The negative is by far the more valuable of the two films in the printer. If the negative is in color its relative value is further increased.

Experiments have shown that it is preferable to apply air to the base of the negative. This forces the negative against the print stock and at the same time away from the printing aperture. Air applied from the negative side, or internal air, is used in conjunction with the normal backing shoe. Pressurizing that part of the printer containing the printing aperture is extremely wasteful of air for the improvement of contact obtained. Air escapes by way of other necessary openings in the printer rather than through the printing aperture. However, the use of compressed air, directed at the negative by jets at the printing aperture to force the negative back against the print stock, has several advantages:

(1) The negative floats past the printing aperture on a cushion of escaping air;

(2) Directing the air toward the point of useful contact results in considerable economy of air;

(3) There is a cleaning action that tends to remove dirt from the printing aperture and adjacent areas, and also from the negative;

(4) It is unnecessary to readjust the backing shoe to obtain optimum contact when the thickness of the raw stock or negative is changed; and

(5) Both negative and print stock follow a cylindrical surface. This is a fundamentally stable configuration reducing the likelihood of nonuniform contact.

The raw print-stock passes over the smooth backing shoe relatively few times and therefore receives little damage by comparison with that previously possible for the negative.

Practical Test

A Bell & Howell Printer, Model J, was equipped with internal air jets, and a comparison was made of results using three methods of obtaining contact. These results are shown in Table I.

Note that the loss of 4.5 db at 4000 cycles, when the backing shoe only was used, is relative to the loss observed when air, either internal or external, assisted contact. Note also the tremendous gain in the number of times the negative can be put through the printer when internal air jets are used. Flutter, mostly the result of nonuniform negative-to-print slippage, remains nearly constant.

An important but not so well known benefit of superior contact is shown in Fig. 2. These curves show the significant

Table I

Method of obtaining contact	Printer passes for equal negative damage	Relative loss at 4000 cycles	Flutter in %
Backing shoe	650	4.5 db	0.07
External air	130	0	0.07
Internally directed air	Over 10,000	0	0.07

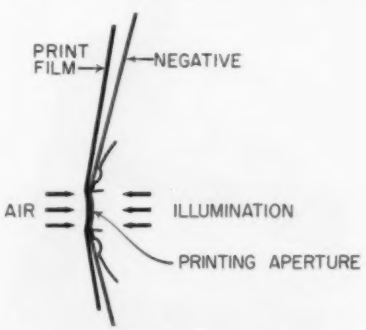

Fig. 1. Illustration of the way external air jets can force the negative against and into the printing aperture (purposely exaggerated).

Presented April 30, 1956, at the Society's Convention in New York by Robert C. Lovick and Howard F. Ott (who read the paper), Color Technology Div., Kodak Park Works, Eastman Kodak Co., Rochester 4, N.Y.

(This paper was received on February 13, 1957.)

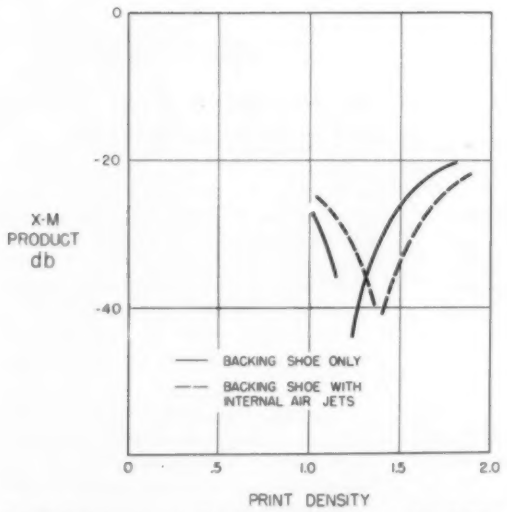

Fig. 2. Improvement of optimal print density of variable-area sound record by improved contact.

improvement of the optimal print density of a variable-area sound record obtained by improving the contact. Reducing the separation of the negative and print stocks provided the same effect as would have been obtained with reduced image spread within the emulsion. The curves were obtained by printing the same negative on the same contact printer with and without internally directed air. For these tests the backing shoe was adjusted for the best contact that could be obtained without air.

The internal air jets were installed on the Model J printer for the preliminary experiments because this installation was relatively simple. When the tests with this printer showed such striking reduction in the wear on the negative as well as better contact, air jets were designed for, and installed in, a Bell & Howell Model D Printer. This printer, which had already exhibited excellent contact, did not show the significant improvement in contact experienced with the 16mm printer when the air jets were used; however, a tremendous gain in negative life was again evident from the tests. No negative damage was apparent after 3000 passes through the printer. Without air, damage was detectable after about 200 passes.

The tests of both the 16mm and 35mm printers were made using a loop negative. Any damage that might have occurred in windup and rewinding was purposely avoided.

Mechanical Assembly

The air jet assembly used in the Model J printer is shown separately in Fig. 3 and installed in the printer in Fig. 4. In this installation, one main structural member is shaped to fit the top of the inside of the printer housing, where it is fastened. This main member extends downward outside of the illumination beam but on the printing-aperture side of the housing. At its lower end it supports two horizontal tubes that extend to positions near the printer aperture, one above and one below the illumination path. The main member is hollow, and carries air from a single connector in the top of the housing to the two tubes, the ends of which support the jets. Each jet is just outside the printer-illumination path, and each directs air through the printer aperture to the base of the negative. Each jet is a slit approximately 0.006 in. wide by $\frac{5}{8}$ in. long, located about $\frac{1}{2}$ in. from the film.

The jet assembly for the Model D printer was built into the light-drum assembly as shown in Fig. 5. Air is introduced through a tube (1) that replaces the stud originally in the printer for holding the light drum from rotating as the printing aperture is changed. Chambers (2) built into the rim of the light drum carry the air to the jets (3) which are just inside the printing aperture (4). Air for the lower jet is carried past the shutter aperture (5) by thickening the drum plates at this point and providing passages (6) through the thickened sections. Air streams from the lower and upper jets are directed through the printing aperture being used. Both jets are adjustable in width and can be cleaned without disassembly of the printer. Optimal adjustment has been found to be approximately 0.006 in.

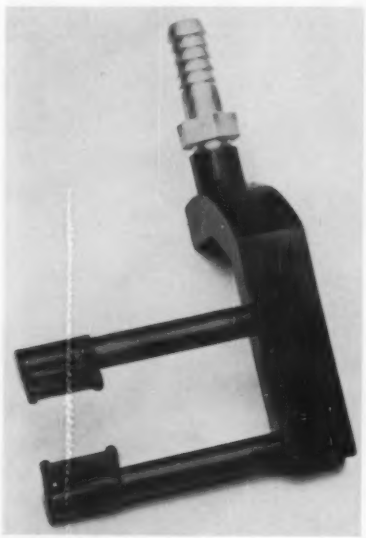

Fig. 3. Air jet assembly.

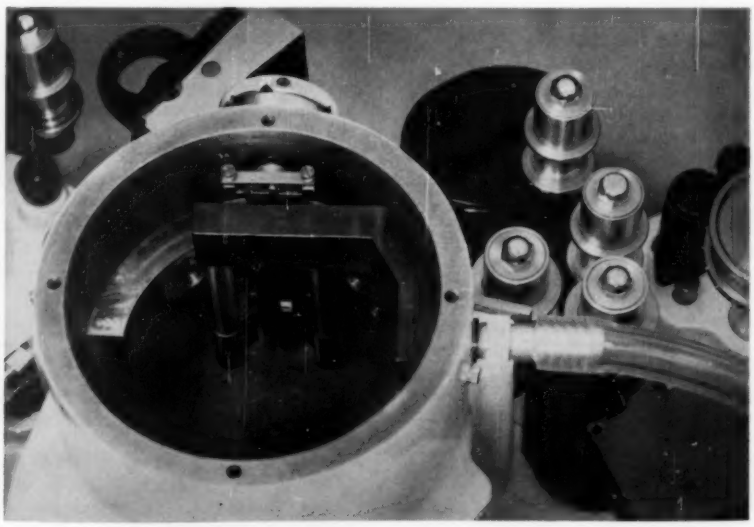

Fig. 4. Air jet assembly installed in Bell & Howell Motion-Picture Printer, Model J.

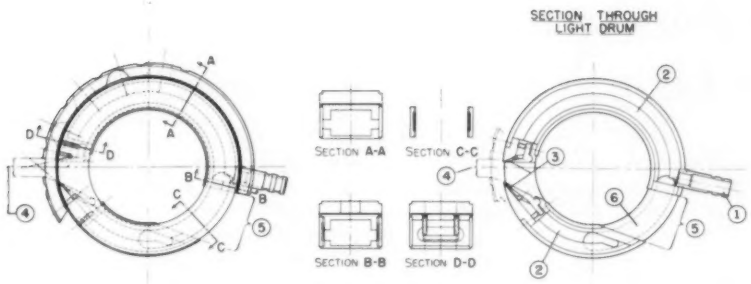

Fig. 5. Light-drum and printer-aperture assembly for Bell & Howell Printer, Model D, showing built-in air jets.

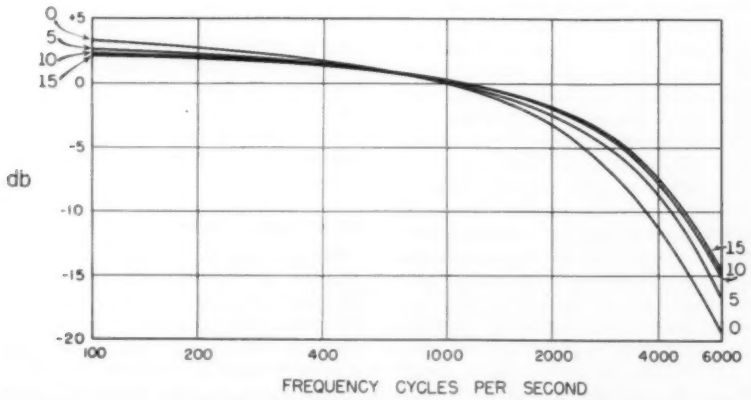

Fig. 6. Frequency response curves for 0, 5, 10 and 15 psi air pressure supplied to the jets in Bell & Howell Printer, Model J.

Each jet is approximately 1 in. long, the full width of the light-drum rim. The jets in both printers are, of course, supplied with filtered compressed air.

Choice of Air Pressure

The frequency response curves shown in Fig. 6 were obtained from tests on the Bell & Howell Printer, Model J, and served as one criterion for choosing the operating air pressure for the jets. These curves indicated that the last significant improvement was that between 10 and 15 psi air pressure supplied to the jets. A pressure of 15 psi has been chosen for operating both printers. Newton's rings are not a problem for air pressures below 25 psi on the films used for these tests.

Conclusion

Extremely good contact with cleaner operation is achieved through the use of internally directed air. The most significant gain of this system is the greatly improved life of the all-important negative. These tests were made on Bell & Howell Printers, Models J and D. There is every reason to believe that significant improvement could also be made on other printers through the use of internal air jets.

Discussion

C. D. Beeland (*Beeland-King Film Prod.*): Can you give us an idea of the volume of air required for the operation of these jets?

Mr. Ott: We have not measured the quantity of air used in this installation. [Since presenting the paper at the N.Y. Convention in May 1956, measurements have been made on both printers in which jets were installed. Optimal jet widths for both printers were about 0.006 inch and at this setting the jets in the Model J consume 6.0 cu ft/min free air at 15 psi and the jets in the Model D consume 11.3 cu ft/min free air at 15 psi.]

Paul S. Peters (*Motion Picture Advertising Service Co.*): Was the printer shoe setting changed or was it left in the normal position for the negative-positive contact?

Mr. Ott: Continual trouble was experienced with the contact in the Model J with the normal shoe setting of 0.014 in., which provided only sufficient clearance for the negative and the raw print-stock. When the jets were installed in this printer, the gate was opened to 0.019 at which point we got better contact without air as well as with air. The gate in the Model D is set at 0.020 with air.

Mr. Peters: Did you change the radius of the shoe?

Mr. Ott: No.

Mr. John E. Nelson (*Byron, Inc.*): Have you experimented with any faster speeds than 60 ft/min?

Mr. Ott: No, we have not.

Mr. Nelson: Do you think that the pressure of the air would have to be above 10 psi?

Mr. Ott: A pressure of 10 psi would be adequate for substantial improvement in contact and negative life. We feel 15 psi is closer to optimal.

pletely dark except for a light line down

Direct-Positive Variable-Area Recording With the Light Valve

By J. HOWARD JACOBS

The mode of action of a bilateral variable-area light valve is reviewed. Light valves which the author has developed for recording direct-positive variable-area tracks, both standard width and double width push-pull, and the modulator in which they are used are described.

Although a number of early attempts had been made prior to 1940* to use light valve for variable-area recording the first public demonstration of its use for this purpose was made by the Bell Telephone Laboratories in 1941. In that year some of the first permanent-magnet sealed light valves were used as a part of their Stereophonic Sound-Film System. These light valves were described by Wente and Biddulph[1] in a paper read before the Society.

The variable-area light valves of today are the direct descendants of those early examples. So that subsequent developments may be better understood, the mode of action of the light valve when used to produce a negative variable-area track will be outlined.

Negative Recording

A pair of coplanar ribbons is suspended in a transverse magnetic field, thus forming a light-slit which is made to vary in width by means of currents flowing in the ribbons. These ribbons are shown in cross section at the top of Fig. 1. They are made from Dural foil 0.0005 in. thick, sheared into strips 0.006 in. to 0.010 in. wide, with the ribbon span in the valve around 0.7 in. to 0.8 in. The ribbon tension is such that the natural frequency of the system is near the upper end of the range of frequencies used in sound-film recording.

Referring again to Fig. 1, the function of the slit mask is to prevent light from getting around the outside of the ribbons. An optical system, represented schematically by a simple lens, focuses the light coming through the slit between the ribbons on to the film, and as the spacing is made to change by means of the electric currents through the ribbons, so the width of the exposed part of the track on the film changes proportionally to give a translation of the currents into a waveform on the film.

The lower part of the diagram shows a negative track which might be produced by such a pair of ribbons. For reduction of the background noise the ribbons are biased to an almost closed position during silent or low-level periods. This produces a thin line (the bias line) down the center of the track. This line is made to widen progressively as higher level program material is recorded, until the bias is completely cancelled when the level reaches a few decibels below the 100% modulation point. A few cycles of full modulation are shown at the bottom of the diagram. When this level (the so-called clash point) is exceeded the ribbons actually clash. In addition to the distortion due to clipping of the waveform, the clashing causes excitation of the ribbons at their natural frequency and gives rise to spurious damped trains of high-frequency waves on the track. This may happen at lower levels on sharp attacks at a time when the ribbons would be biased close together. How the new direct-positive light valves avoid this trouble will be explained later.

By using various ribbon arrangements and suitable electrical connections it is possible to record quite a variety of negative tracks. The state of this art, as it existed in 1948, has been admirably dealt with by Frayne.[2] A further variation due to Browder[3] makes use of a biplate in association with the objective lens of the light valve for the purpose of image-doubling. In this way two identical negative tracks may be laid down side by side in the space normally occupied by the standard bilateral track. This has an advantage for minimizing certain types of distortion.

Direct-Positive Recording

When magnetic recording came into general use in the studios the need arose for a positive photographic track for use in the cutting room. This would normally be printed from a negative but ways were soon sought for eliminating the expense of this preliminary stage. The problem of direct-positive variable-area recording with the light valve received early attention. Suppose the track shown in Fig. 1 were printed: the print would appear dark at the edges and light down the center. When full bias is applied in the absence of modulation the track would be com-

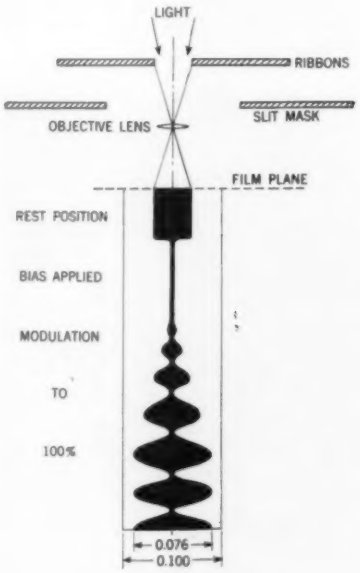

Fig. 1. Schematic, bilateral negative recording.

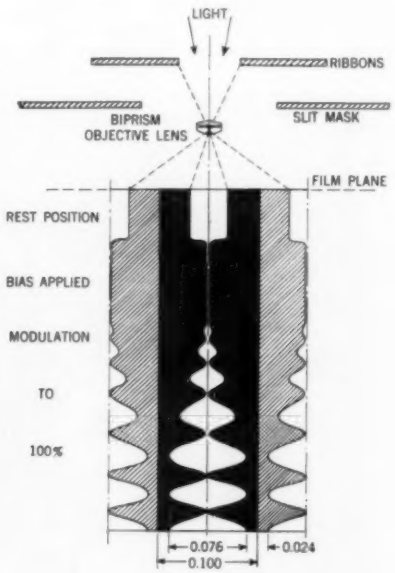

Fig. 2. Schematic, bilateral direct-positive recording.

Presented on December 11, 1956, at the Society's Hollywood Section Meeting, by J. Howard Jacobs, Westrex Corp., 6601 Romaine St., Hollywood 38.

(This paper was received on December 17, 1956.)

* For example, Burton F. Miller at Warner Bros. Pictures modified a variable-density light valve so that it produced a track with many of the attributes of variable-area recording. It is this track which is referred to in N. Levinson's "A New Method of Increasing the Volume Range of Talking Motion Pictures," *Jour. SMPE, 26:* 111-116, Feb. 1936.

pletely dark except for a light line down the center. Means were sought to produce such a positive track in the form of an original recording.

One method was to use the light reflected off the ribbons in the light valve instead of that which passes between the ribbons. In this way exposure is given to the edges of the track, whereas the center aperture between the ribbons gives no exposure. This method was worked out by Browder[4] and has been in use for some years for the production of direct-positive recordings.

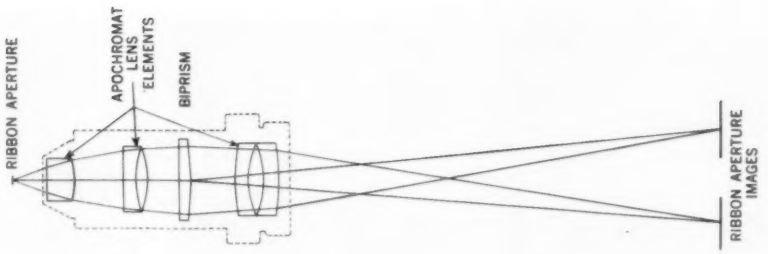

Fig. 3. Action of biprism in light-valve objective lens.

Direct-Positive by Transmission

Although the reflective-ribbon method offered a quick solution to the immediate problem, it required optical changes in the recorder and special ribbons in the light valve. Although reflectivity was improved, there was a lessening of tensile strength with a consequent inability to hold a high tuning point. Hence, it was generally agreed that the ultimate goal was a system that would record direct-positive tracks by transmission of light rather than by reflection. Apparently, if the negative track could somehow be split down the middle and then transposed edges to center, by some device incorporated within the light valve, a good quality and conveniently obtainable direct-positive track would result. This was achieved very simply in the case of the standard bilateral track by using an image-doubling device very similar to that mentioned already in connection with the double bilateral negative track.

Figure 2 shows schematically the effect of such an image-doubling device when the spacing between the ribbons and the distance between the two image centerlines have been adjusted to produce the effect shown in the lower part of the diagram. When the part of the image outside the standard track area is masked, that which remains is a direct-positive track.

Compared to the arrangement used to make a double bilateral negative track, only two changes were necessary; the spacing between the ribbons was increased by some 63% and the total centerline displacement produced by the beam-splitting device had to be increased by a factor of nearly 3. There was, of course, no impediment to changing the ribbon spacing, but it was found that the increase of separation of the two centerlines was beyond the power of a biplate which could be accommodated within the objective lens of the light valve.

A biplate functions by displacing laterally the rays which traverse it and they emerge parallel to their original directions. The amount of the displacement is a function of the angle of inclination of the plate and is also directly proportional to its thickness. In this instance neither the angle nor the thickness could be increased sufficiently within the limitations of the space available between the elements of the objective lens. It was therefore necessary either to use the biplate externally to the light valve with considerable sacrifice of convenience of adjustment and operation, or to find some more powerful device which would give the required separation and still conform to the space limitations.

The Biprism

Such a device is the biprism, which is shown in cross-section installed in a light-valve objective lens in Fig. 3. It consists of two narrow prisms joined base to base, and usually, as in this case, one of the base angles of each prism is made a right angle so that the biprism may be made of a single piece of glass with a ridge on one side only. A biprism does not displace the rays of light laterally; instead it changes the direction of each ray which traverses it by a small amount which depends on the angles of the sides of the biprism.

Because the image is to be projected a comparatively large distance (about 6 in.) compared to the scale of the image formed by the system, an optical leverage effect is obtained, in that a small change in the direction of a ray at the biprism results in a comparatively large displacement of the image to which it contributes. Hence, obtaining the necessary displacement was no problem once the change was made from a biplate to a biprism. The biprism does, however, introduce a small amount of chromatic aberration. This is visible upon critical inspection of the visual monitor screen, but it does not register on the film because the emulsion of the sound-recording stock is sensitive only to a relatively narrow band in the neighborhood of 4000 A, and no degradation of the track definition has been detected.

The angles of the biprism, which control the amount of image displacement, can only be determined with some knowledge of what is going on inside the six-element apochromatic lens assembly in which it is installed. A detailed account would be out of place in this paper, but it may be said that the final (triplet) lens sees a magnified virtual image of the light-valve ribbons which is about 3½ in. ahead of it on the optical axis; that is, over to the left of Fig 3. When a biprism is interposed between this image and the lens, it causes this virtual image to appear double. The angles of the biprism are computed to give a desired displacement between the two virtual images which will in turn give the necessary separation between the final real images at the film plane.

Overload Characteristics

In this way it is possible to arrive at a practical embodiment of the scheme shown in Fig 2. Not only does this method give a positive track from a single recording step, but it has other advantages which become apparent upon further examination of the diagram.

It should first be noted that the instantaneous separation of the ribbons in the upper part of the diagram may be deduced from the instantaneous width of the exposed (dark) part of the track. The ribbon spacing is in fact proportional to the width of either half of the track before it is masked as mentioned earlier. It may be deduced from this that at no time do the ribbons touch each other; in fact, when full bias is applied the ribbons have to be at their widest separation. Accordingly, the wiring to the ribbons has to be reversed compared to that of the negative light valve, so that the ribbons move apart rather than together as the bias is increased. For this reason a sharp attack when full bias is applied does not cause a mechanical clash of the ribbons. Also it may be seen that when the track is fully modulated the ribbons do not close at any time.

There is a margin of about 4½ db beyond the 100% modulation point before mechanical clash occurs, and this of course gives less distortion at overload as well as lessens the possibility of ribbon damage. It is therefore necessary to distinguish between "mechanical overload" in which the ribbons actually touch, and "optical overload" in which

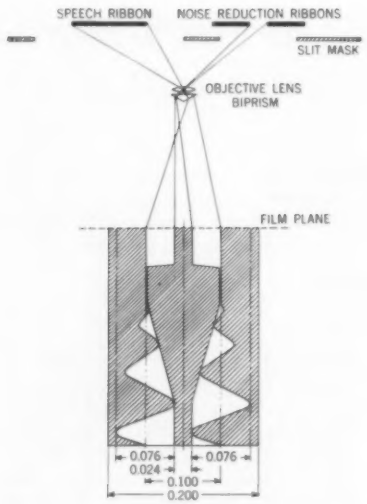

Fig. 4. Schematic, push-pull direct-positive recording.

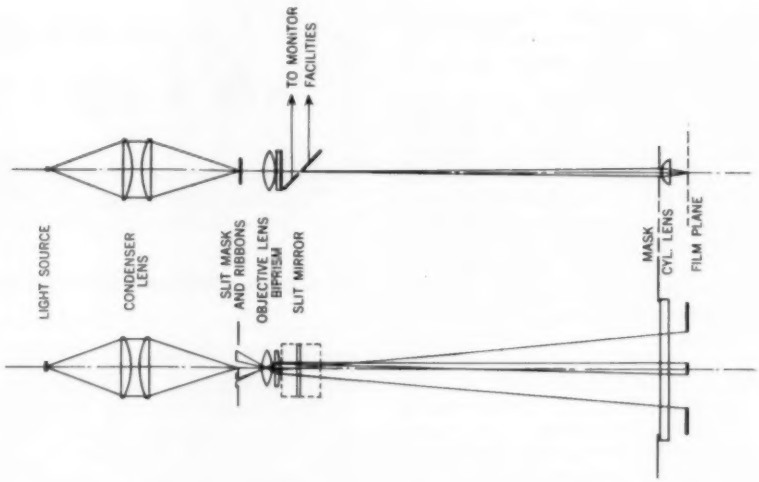

Fig. 6. Optical schematic, push-pull direct-positive recorder.

the two exposed parts of the track meet at the center. Driving the valve into the region between optical and mechanical overload does no harm to the ribbons and results only in some clipping on the track. Actually, the two images coming in from either side meet at the center and overlap slightly. At the other end of the excursion the image may swing off the end of the reproducer slit, but there is no distortion of the waveform at the track edges until mechanical overload occurs.

Direct-Positive Push-Pull Recording

When attention was turned to the problem of a direct-positive push-pull track, it became evident that a somewhat different approach was necessary. No simple doubling of the image from a push-pull negative light valve or from any other existing arrangement was going to provide a positive track which satisfied such requirements as (a) the modulation in the two halves of the track to be 180° out of phase, preferably to be accomplished by a single speech ribbon, and (b) when there is no modulation, the track is to be darkened except for two bias lines which should preferably be down the centers of the two half tracks. There appeared to be no way of reproducing in one stage the track which is obtained by printing from a negative push-pull image, so a completely new, but compatible, soundtrack had to be devised.

The method of obtaining the new direct-positive push-pull variable-area soundtrack is shown in Fig. 4. Before considering the arrangement of ribbons and slit mask shown here, suppose for a moment that a single speech ribbon is strung centrally, that is, on the optical axis of the objective lens. This will cast a shadow across the center of the track. The light passes each side of the ribbon and blackens the edges of the track, exactly as shown in the lower part of the diagram. When the speech ribbon moves this will give the required out-of-phase modulation in the two halves of the track, but during low-level passages it is necessary somehow to blacken the center of the track, leaving, of course, the required bias lines.

Suppose next that the speech ribbon is removed and there is substituted a bilateral pair with its outer edges obscured by a slit-mask, as in a standard-width bilateral light valve. By this means it is possible to lay a blackened area down the center of the track, and to vary the width of this with the bias current. The whole area may be blackened, or the width of the strip may be narrowed to the standard 24-mil septum of the push-pull track. This effect is shown in the center of the track.

It is obviously impossible to obtain a variable-width optical image for noise-reduction purposes by transmission through the center of the speech ribbon, so the problem becomes that of obtaining the two images, speech and noise reduction, at the same time and in the same place while using only one light valve. This is solved by again using a biprism within the objective lens of the light valve, but for a purpose which may be thought of as the opposite of that for which it was used in the standard-width direct-positive light valve. In this instance the image is synthesized from the two separate systems shown in the ribbon plane at the top of the diagram in Fig. 4. On the left the speech ribbon is positioned so that light may come past each edge to give the blackening towards the edges of the track. On the right a bilateral pair supplies the central noise-reduction image. The biprism in the objective lens causes it to project two

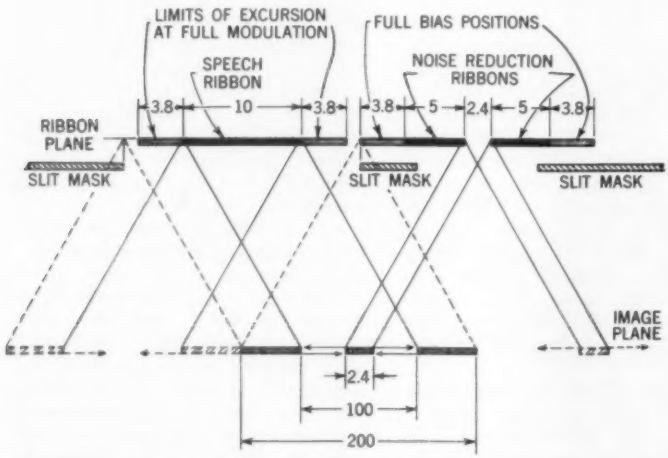

Fig. 5. Ribbon and image movements in push-pull direct-positive recording.

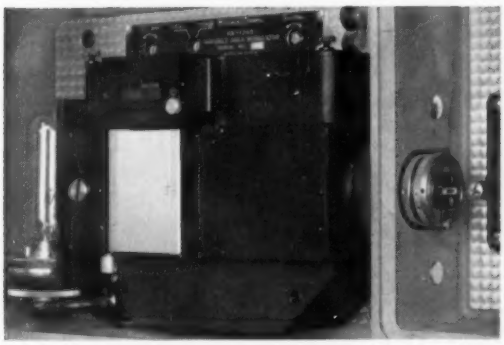

Fig. 7. Modulator with light valve installed.

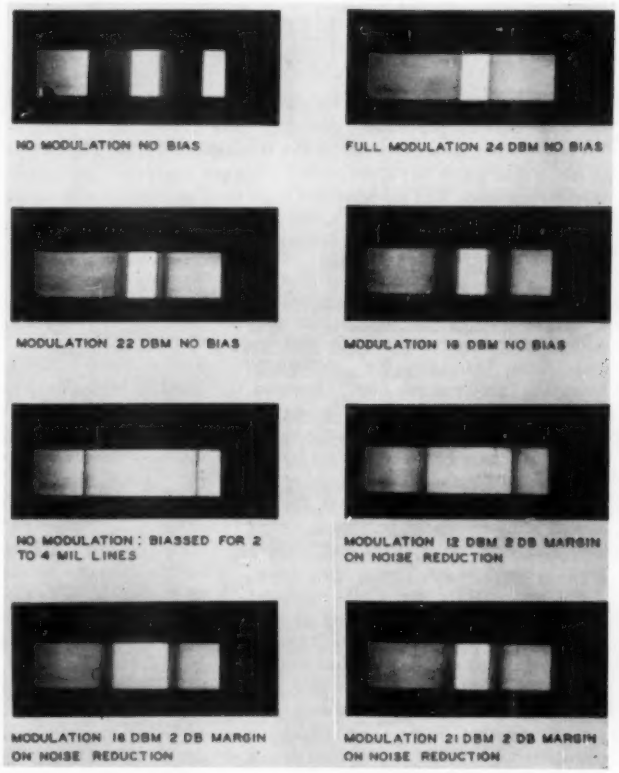
NO MODULATION NO BIAS
FULL MODULATION 24 DBM NO BIAS
MODULATION 22 DBM NO BIAS
MODULATION 18 DBM NO BIAS
NO MODULATION: BIASSED FOR 2 TO 4 MIL LINES
MODULATION 12 DBM 2 DB MARGIN ON NOISE REDUCTION
MODULATION 18 DBM 2 DB MARGIN ON NOISE REDUCTION
MODULATION 21 DBM 2 DB MARGIN ON NOISE REDUCTION

Fig. 8. Visual monitor screen in various recording conditions.

complete images of the ribbon plane on to the film plane. The power of the biprism is computed so that the center of the noise-reduction component of one image falls on the center of the speech ribbon component of the other image; or to put it another way, the image of the noise reduction aperture is projected on to the center of the speech ribbon shadow. Other parts of the two images fall outside the track area, and these are masked off. In this way the image has been synthesized from two assemblies in the ribbon plane which have been optically superimposed in the film plane.

As with the new bilateral direct-positive light valve, there is considerable margin beyond the optical overload point before mechanical overload occurs. This is apparent from Fig. 5 which shows the arrangement of the ribbons and slit mask in cross section, together with the image which they form. The diagonal lines show diagrammatically how the various parts of the image are derived from the different edges of the ribbons and the slit mask. That part of the resultant composite image which is ordinarily masked off is shown in broken lines. The positions of maximum excursion of the speech and noise-reduction ribbons at 100% modulation and full bias respectively have been marked. It is seen that even with full bias applied there is still some margin for ribbon excursion beyond the 100% point. With the bias cancelled, as would normally be the case on heavy passages, this margin is around 8 db. Operation with full bias at all times is quite feasible, and this of course produces a Class B track.

The Modulator

Figure 6 is an optical schematic of part of the recorder known as the modulator in which this light valve is used. Light from the recording lamp is imaged by the condenser lens onto a plane near the light valve ribbons. The objective lens with its biprism throws an image of the direct-positive soundtrack on to the film as has been described. There is a mask close to the film which prevents the unwanted part of the image from registering on the film. In the vertical plane there is effective an additional system consisting of the slit mirror behind the light-valve objective lens, and a cylinder lens close to the film. The cylinder lens throws an image of the slit on to the film, and so reduces the slit height to a suitable value at the film plane.

The light which does not pass through the slit in the slit mirror is reflected off its first surface and is utilized in an optical system (not shown) which performs two functions. The first is to give a 60 × magnified image of the ribbons on a ground-glass screen, and the second is to supply a phototube with a part of the light so that the signal from the light valve may be heard and monitored as to level, distortion, etc.

Figure 7 shows the relationship of the recording lamp, the light valve, the cylinder lens and the visual monitor screen. The track mask is just in front (to the left in the picture) of the cylinder lens. A vertical movement adjusts it for two positions, one for standard-width bilateral and the other for double-width push-pull. A larger mask with a similar function is installed just behind the visual monitor screen. This mask is adjusted for the track width in use by sliding it laterally. Pictures taken under various conditions of excitation of the light valve are shown in Fig. 8. The 2-db margin on the noise reduction was used for the purpose of illustration. In practice somewhat more than this is used.

Conclusion

The performance of these light valves is in every way equivalent to that of similar negative-type light valves, but with two advantages. There is no possibility of degradation in the printing process; and the direct-positive light valves, due to their superior overload characteristics, produce tracks which are freer from distortion at higher levels.

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Automatic Film Inspection

By ROBERT GRUNWALD and RICHARD R. WALLACE

A serious problem in 16mm sound-film distribution has been release-print inspection. Manual procedures generally have proved inadequate. A machine, the Inspect-O-Film, manufactured by the Harwald Co., is used in an automatic system of inspection which has a considerably higher degree of speed and accuracy than manual methods. The machine has been used in 16mm nontheatrical distribution for several years. Recently a model for television use has been introduced. This paper describes the principles of operation and discusses the application to inspection and editing in various fields.

SINCE MOTION-PICTURE distribution began there has been the particularly annoying problem of film inspection. The basic method until the advent of automatic film inspection was the use of a glove or tissue held on the film by the film inspector's fingers as the film was rewound. The theory was that the inspector's fingers would be able to detect improperly made splices and defects which could cause poor projection. Also, presumably, the cloth or tissue would catch on any snag, such as edge cuts, which could lead to trouble. For 35mm film this method has seemed to provide fair results. However, for 16mm sound film which has only one set of sprocket holes, and which is distributed to a highly diversified group where projectionists are almost invariably amateurs, hand inspection has not provided an adequate solution to the problem. It has been found that if a defect is missed on one inspection, it will often lead to more extensive damage on the next projection. As a result, the situation goes from bad to worse and replacement footage becomes a significant factor in 16mm library operation.

The basic idea of the original model of the automatic film inspection equipment, which we have named "Inspect-O-Film," is also fundamental to the present automatic inspection equipment. It consists of a power transport passing the film through an automatic defect detector, which in the first experimental unit checked only for enlarged sprocket holes and edge cuts. The design was quickly expanded to include checking for cellophane tape and similar poor splices. When the machine would come to such a defect it would stop automatically and indicate the nature of the defect by means of a lamp.

After considerable experimentation and modification, the Model F machine was marketed. The Model F checked for enlarged or torn sprocket holes and bad splices, measured the footage of the film, counted the good splices and cleaned the film. These machines were used first at Ideal Pictures, Modern Talking Pictures and the Marine Corps. The first machines were vertical (Fig. 1). This seemed to be the most practical way to conserve precious floor space in a film library; however, before long some rather interesting facts became apparent.

Since the take-up reel was on the bottom of the machine, it was necessary for the operator to stoop down in order to change it. This did not present any serious trouble to women film inspectors; however, the men found it objectionable. Since the machine had to be universal in its application, a horizontal model was adopted. The first Model G consisted simply of a Model F tilted 90°. During the approximately two years that this model was on the market, numerous changes were made, such as adding a sprocket drive for the footage counter, improved facilities for cleaning film, and improved control and transport mechanism.

The first extensive field experience with the equipment was obtained when Modern Talking Picture Service purchased 26 Model G machines and installed them in all of their offices throughout the country. Reports from the exchanges showed a reduction in defects from three per 1200-ft reel to one per three 1200-ft reels, with good results from the machines in both speed and accuracy and it was also found that after the films were once passed through the apparatus one operator could easily operate two machines.

Following Model G came Model H which incorporated the main features of Model G plus a much improved defect detector and simplified and improved circuitry. The current model is Model R (Fig. 2) which maintains the basic design of model H, plus certain refinements and improvements such as all-metal housing and tubular legs.

The Mechanism

The machine accommodates reels ranging from 50 ft to 2000 ft of 16mm film, sound or silent. The film transport operates as follows: The film is driven by a rubber-covered capstan at the rate of approximately 450 ft/min. The film travels from left to right and is taken up on the righthand reel spindle. The take-up spindle is driven through a slipping coupling similar to the type used on many projectors. This permits the film to be kept at a uniform tension, regardless of reel radius. The capstan is driven through a belt reduction from a $\frac{1}{10}$-hp series motor and the take-up is driven from a belt off the capstan shaft. The feed reel spindle is coupled directly through a resilient coupling to a similar motor for rewinding.

Naturally, with the film traveling at 450 ft/min, it is necessary to have some rather strong measures taken to brake the reel when the machine stops. These are provided in two ways. First, the external brakes operate on the edge of the reel and in addition, two internal brakes operate on the drive and rewind motors respectively. It would be possible to obtain adequate braking action using only the brakes on the motors; however, there would be tearing of the slot in the reel.

The defect detector (Fig. 3) is, of course, the heart of the machine. The thickness functions, namely, splice and thickness defects, are detected by rollers R and U. The rollers are mounted on ball bearings and are spaced 0.0075 in. apart. As the film passes between these

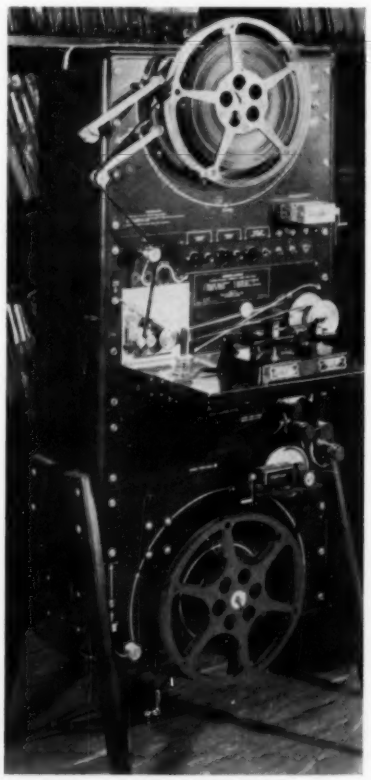


Fig. 1. Early Model Inspect-O-Film.

Presented on May 2, 1956, at the Society's Convention at New York by Robert Grunwald and Richard R. Wallace (who read the paper), The Harwald Co., 1216 Chicago Ave., Evanston, Ill.

(This paper was received on January 10, 1957.)

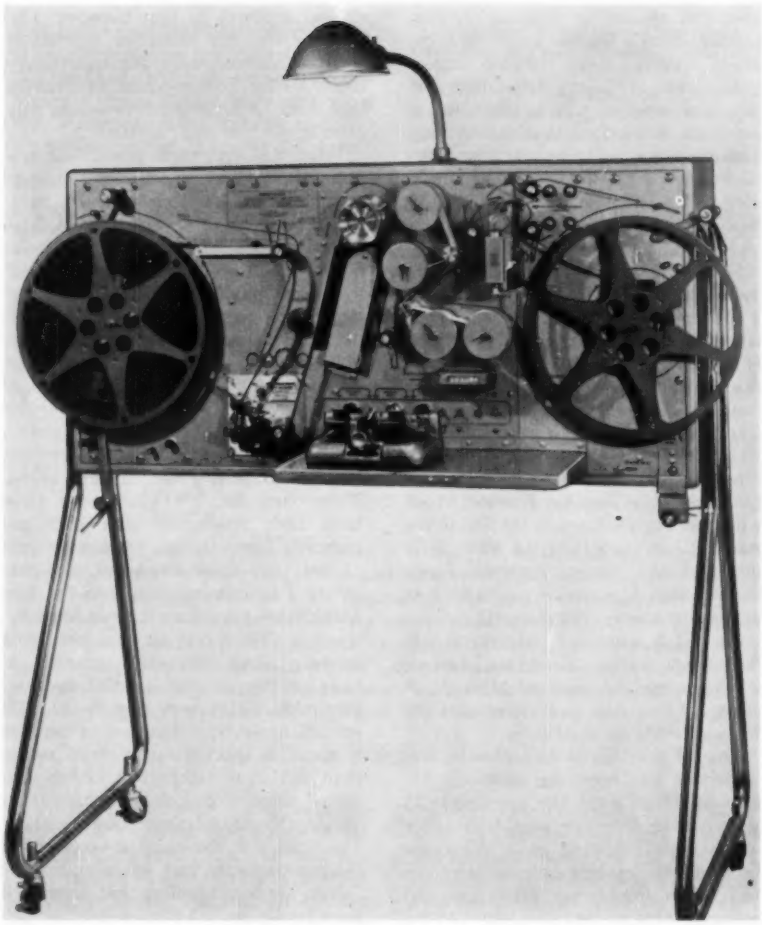


Fig. 2. Front view of Model R Inspect-O-Film.

rollers, it will normally have no effect on their position. However, when the film exceeds 0.0075 in. in thickness, roller R will be actuated with the result that contacts C and D will separate, causing an electrical pulse to be introduced into the electronic circuit. An electric timing circuit determines whether this pulse is generated by a splice, sprocket punch, or by a cellophane tape splice. This system is highly reliable and does not damage the film in any way.

From the thickness rollers the film passes over a pulley (Fig. 4). There are two jewels mounted on metal springs which track the film in the sprocket region (Figs. 5 and 6). The jewel attached to B rides down the center of the sprocket hole. It has a flat on it, as shown in Fig. 5, which is slightly longer than a normal sprocket hole. In the case of an enlarged sprocket hole, this jewel will fall into the sprocket hole and close the associated contact. This will actuate the electronic circuit which will stop the machine and light an indicator lamp denoting a sprocket defect.

The "small" jewel tracks the film (Figs. 5 and 6) between the outer edge of the sprocket hole and the edge of the film. It is somewhat smaller than the so-called large jewel, but the action is identical. Its main function is to detect edge cuts and notches. It is also useful for detecting splices which have started to separate. The small jewel circuit may be disabled with the notch by-pass switch if a film has an excessive number of notches in it and the film library does not wish to do anything about it.

In addition to the defect-detecting facilities of the Inspect-O-Film, there is also an automatic electronic splice counter. This is a very convenient feature and permits a library to obtain a useful index of the quality of the given print without continuously resorting to projection. An excessive number of splices at the head of the film indicates that the print has seen most of the service which may be expected of it. Also, in other types of applications it permits preview prints to be checked for possible cutting or stolen footage. The matter of stolen footage, of course, may also be checked with the footage counter.

Machine Operation

The machine is operated as follows: If a film is received at the library "heads up," it is installed on the right end of the machine, threaded around a pulley, underneath the splicer table, underneath another pulley, and wound onto the lefthand reel. The rewind start button is pressed and the machine begins to rewind. The rewind speed is controlled

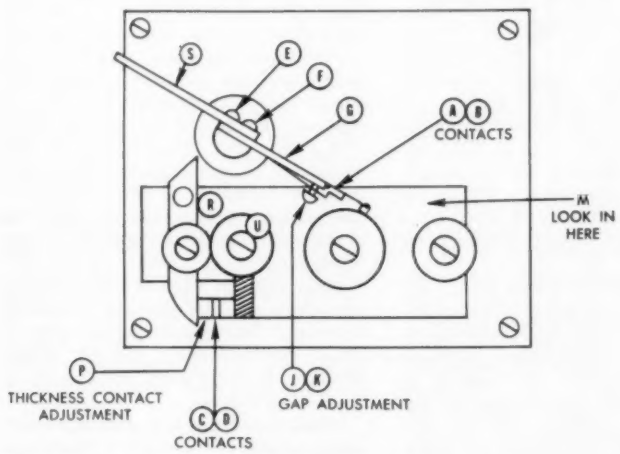


Fig. 3. Detecting mechanism showing adjustments.

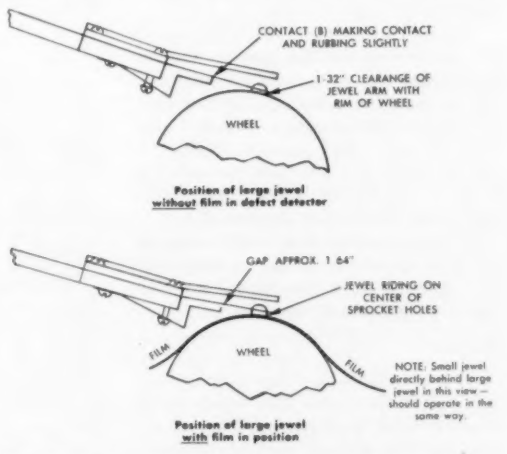


Fig. 4. Position of large jewel without and with film.

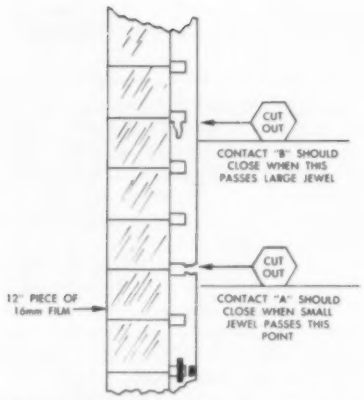

CUT OUT
CONTACT "B" SHOULD CLOSE WHEN THIS PASSES LARGE JEWEL
CUT OUT
12" PIECE OF 16mm FILM
CONTACT "A" SHOULD CLOSE WHEN SMALL JEWEL PASSES THIS POINT

Fig. 5. Method of making test film.

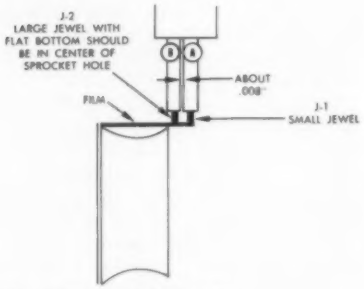


Fig. 6. View of edge of film.

by a rewind speed-control knob; at the end the film stops automatically. This is due to the fact that when there is tension on the lower pulley, a microswitch is actuated which permits the rewind to operate; thus, when that pulley is slack, it opens the circuit, thereby stopping the rewind motor and applying the brakes.

The film then is threaded first over the snubber arm and into the defect detector. From the defect detector it goes over a capstan. It is between the defect detector and the capstan that the defect is displayed when it is located by the defect detector. From the capstan it goes through the cleaner tapes.

The cleaner tapes are specially treated to remove dust and dirt from the film on both sides in a fully automatic manner as the film passes through the machine. They move automatically and are driven by 1/30-rpm clock motors. From the cleaner tapes the film goes through the footage counter or takes the by-pass path over the footage counter for convenience if one does not wish to measure footage. From the footage counter the film goes onto the take-up reel and the machine is ready to operate.

Results

The apparatus is designed to detect any defects in 16mm film which could cause trouble in projection. First of all, the machine detects torn or enlarged sprocket holes. Although torn sprocket holes can usually be detected by reasonably careful hand inspection, enlarged sprocket holes present considerably more difficulty. Oftentimes the claw in a projector will, in effect, reperforate the film with a clean punch; and since there are no corners or raised surfaces to snag on the inspector's glove, they will usually go by undetected although they are every bit as dangerous on projection.

Sprocket punch or roping is detected by the machine. This defect, although it is generally less important than enlarged sprocket holes, still is something of a hazard. The thickness detector finds this defect easily. Good splices are counted and weak splices are detected. Generally a weak splice will be one which has started to separate. This type of defect is detected in two ways. One is with the sprocket detector, which will sense any weakness in the film in the sprocket hole area; and the other is by the machine's putting more tension on the film than does a projector under normal circumstances. Therefore, if a splice is going to fall apart in a projector, it will fall apart during inspection instead, when it can be repaired without ill effect. Broken film is detected and the machine stops automatically.

One of the biggest nuisances to film inspectors has been the unusually ingenious splices some film users make in film. Among these are pins, both safety and straight, chewing gum, cellophane tape and staples. Naturally, these splices will cause trouble on projection and many of them would cause injury to the inspector's fingers in the case of hand inspection.

Oftentimes a carefully made cellophane tape splice will be missed by hand inspection, especially if it has managed to get through a projector once or twice. The apparatus detects this type of defect very easily and there is no risk of damage to the technician's fingers.

One of the machine's features of importance to film libraries is the "notch by-pass." Since most of the older films in nontheatrical film libraries are extensively notched and, since, if the notches were to be replaced by splices, the film would lose a great deal of continuity, it is often desirable to by-pass the notch defects. This process increases production considerably and if properly used does not significantly reduce the overall quality of a library's films; however, this feature should be used with discretion.

There are certain things which the Inspect-O-Film will not do. First of all, it will not detect cuts on the soundtrack side of the film. These defects, although they may be slightly objectionable as far as sound quality is concerned, do not provide a significant hazard on projection. Secondly, their frequency is low enough so that they do not pose a substantial problem to film libraries. The machine is not designed to detect scratches automatically, although the Inspect-O-Film Editor comes as close to that with its high-speed viewer as any existing piece of equipment.

When this equipment is installed in a film library which previously has been operating with hand inspection, a number of problems are raised. One of these is that the film exchange has the choice between high production with somewhat less than maximum accuracy or relatively moderate production approximately equal in quantity at first to that obtained with hand inspection of high accuracy. Almost invariably exchanges choose the latter alternative. Despite the fact that they are considerably upgrading their prints, they sometimes still feel that they are not getting their money's worth. They often ask, "Why can't we have both high production and high accuracy?" These are two reasons for this:

First, and more important, the machines are detecting defects in the film which have gone unnoticed in hand inspection. The result is that the units produce about the same number of films per day as were handled by hand previously. The very significant difference, however, is that most of the time is spent in splicing out defects, rather than in actual inspection. After this initial phase is completed, which takes varying lengths of time—but is usually about three to five months—production increases sharply and fewer and fewer defects are found in films that come back from bookings.

The second problem involves the operator's skill in using the equipment. Actually, the apparatus is relatively simple to operate; however, as with any such piece of equipment, there is a certain amount of time involved before the operating personnel become highly adept in its use. Taking 400-ft reels, as an example, the "first-stage maximum quality" condition, which is the condition usually elected, shows an average production of about 100 reels each day by hand inspection. Naturally there are variations among libraries, but this is a fairly accurate average. Using one Inspect-O-Film operated by one inspector, the output initially is about 115 reels a day. Sometimes, when the films are in considerably worse than average condition to start with, the production is actually less than 100 reels a day, although this situation is relatively rare.

After this first stage of familiarization and cleaning up of prints is completed, however, the production increases to about 180 reels each day. A similar situation is found with 1400-ft reels as well as other sizes.

Finally, and this is a very important point indeed, the personnel who operate the inspection machine have been re-

lieved of most of the tedium of inspecting films. They do not have to rely on antiquated and laborious methods of detecting defects. Rather, they can work with a machine which in effect does the the tedious part of their work for them.

Discussion

Emmett Salzberg (Criterion Film Laboratories): I notice that the operator has to rethread every time a reel is inspected. Is that correct?

Mr. Wallace: At the present time, that's the way it operates. The loading takes between 10 and 20 sec.

Mr. Salzberg: Have automatic elevators and snubbers such as the ones used on developing machines ever been considered? Wouldn't their cost be offset by the fact that the operation would then be continuous rather than intermittent? This would also eliminate the brakes?

Mr. Wallace: It's worth considering, although in film library operation there are certain conditions which do not make that type of thing as suitable as it would be in a processing laboratory.

Mr. Salzberg: I'd like to know how the film-cleaning tapes clean the film?

Mr. Wallace: They clean it essentially mechanically. There is no significant solvent action involved. The silicone fluid on the tapes has the advantage of attracting dust and dirt pretty well—it's very much the same principle as an oily cloth although the amount of the fluid transferred to the film is negligible. The antistatic agent present does not transfer either. It is there primarily to keep the static charge from building up on the tapes themselves.

Absolute Measurement of Signal Strength on Magnetic Recordings: Phase II

By ROBERT SCHWARTZ

The Material Laboratory has developed a method for measuring the magnetic strength existing on 16mm magnetic soundtrack by utilizing a nonmagnetic loop for the determination of the absolute surface induction at 400 cycles/sec for "pegging" the relative surface-induction vs. frequency characteristic obtained by the "short" gap or other approved method. This paper indicates that this method was found to be practical for determining the surface induction for signals recorded on the currently manufactured 16mm magnetic-coated film, independent of differences in their characteristics and the depth of penetration of the recorded signal.

In a previous paper,* there was described the method developed at the Material Laboratory for the absolute measurement of signal strength on magnetic recordings. The method entailed the use of a single turn nonmagnetic loop specifically designed for the purpose. With the loop it was possible to determine the absolute surface induction (a measure of signal strength) at a recorded wavelength of 18.75 mils (e.g. 400-cycles/sec signal recorded at a tape speed of 7.5 ips (inches per second)). This absolute value of surface induction was then to be used as a reference for a relative surface-induction vs. frequency characteristic obtained by the "short gap," "long gap" or other approved method for determining the relative surface-induction characteristic.

The results of this phase of the investigation had shown that the overall variations in values of surface induction for a specific recorded signal was 1.6 db for measurements with eight different loops. When repeating measurements with the same loop the overall variation was no greater than 0.6 db. It was also shown that the single turn nonmagnetic loop measurements were not dependent on the depth of penetration of the recorded signal, the oxide orientation or other variations in tape characteristics found among commercially available magnetic tapes. It was therefore concluded that this method was feasible for use on $\frac{1}{4}$-in. magnetic tape as the recording medium.

Extension to 16mm Magnetic-Coated Film

Measurements were performed using 16mm magnetic-coated film as the recording medium to determine whether the method used above would be equally applicable for measuring the signal strength of a 400-cycle/sec signal recorded on 16mm magnetic-coated film (full-width coating) at a film speed of 7.2 ips.

The equipment utilized in this phase of the project was the following:

(A) A commercial 16mm magnetic-film recorder-reproducer (center-tracking).

(B) A 16mm film phonograph drive mechanism which was modified at the Laboratory for magnetic recording and reproducing using a 250-mil head and the associated circuitry of a standard commercial magnetic tape recorder.

(C) All known types of commercial full-width magnetic-coated film obtained from the major magnetic-film manufacturers.

(D) Nonmagnetic loops of the same type described in the paper previously referred to.

To determine the suitability of the nonmagnetic loop method for measuring the normal surface induction under practical conditions utilizing magnetic-film equipment, the following information was obtained:

(A) The extent of variation of the measured normal surface induction, B_y, among several nonmagnetic loops using different personnel for performing the measurement, and the repeatability of measurement with a single loop.

(B) Determination of the effect on the output of the single turn nonmagnetic loop of various magnetic-coated films of different oxide orientation, exemplified by the current production of all the known magnetic-film manufacturers, as compared to its effect on the output of a playback head.

(C) Determination of the effect of depth of penetration on the loop output as compared to the output of the playback head.

(D) Determination of "fringe effects" (the effect on the voltage output when reproducing a magnetic-coated film with a narrower head than the one used in recording).

Theoretical Considerations

All the measurements of the normal surface induction B_y in this phase of the project were performed at 400 cycles/sec at a film speed of 7.2 ips. The equation that was used to determine B_y is the same as the one previously derived in the previous paper:

$$B_y = \frac{E}{vw\left(e^{-\frac{2\pi s}{\lambda}}\right)\frac{\left(1-e^{-\frac{2\pi d}{\lambda}}\right)}{\frac{2\pi d}{\lambda}}\frac{\left(\sin\frac{\pi b}{\lambda}\right)}{\frac{\pi b}{\lambda}}}$$

A contribution received on October 30, 1956, from Robert Schwartz, Material Laboratory of the Navy Dept. (Code 931), New York Naval Shipyard, Brooklyn 1, N.Y. The material presented in this paper is being used for a Master's thesis at Polytechnic Institute of Brooklyn, Brooklyn 1, N.Y. The opinions or assertions made in this report are the private ones of the author and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

*Robert Schwartz, Sheldon I. Wilpon and Frank A. Comerci, "Absolute measurement of signal strength on magnetic recordings," *Jour. SMPTE, 64:* 1–5, Jan. 1955.

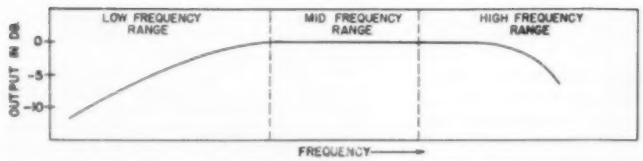


Fig. 1. General overall loop output from recorded tape with B_y αf.

where:

B_y = rms value of magnetic induction normal to, and at the active surface, of the film (volt-sec/sq in. For B_y in gausses, multiply by 1.55×10^7);
E = rms value of output voltage for the loop (rms volts);
v = speed of the film (ips);
w = width of film contributing to flux in the loop (in.);
d = depth of principal conductor of a nonmagnetic loop (in.);
*b = thickness of principal conductor of a nonmagnetic loop (in.);
λ = wavelength of recorded signal (in.);
s = spacing between loop and magnetic material (in.).

*In this case, as in the previous paper, $\frac{\sin \frac{\pi b}{\lambda}}{\frac{\pi b}{\lambda}} = 1$ over the range considered.

The method described in the previous paper for the determination of the "d" dimension of the nonmagnetic loop and "s," the spacing between the loop and magnetic material, for use in the above equation, had to be modified for this phase of the work. In the previous method, used for $\frac{1}{4}$-in. magnetic tape (at a tape transport speed of 30 ips), a constant current tape recording reproduced with the loop resulted in an output vs. frequency characteristic of the type shown in Fig. 1. In the low-frequency range, there was a fall off in response when reproducing the constant current recording as in this region, where d/λ tends to zero, the output of the loop is a function of B_y which in this case was increasing at the rate of 6 db/octave. This occurs up to the point where the wavelength approaches the "d" dimension of the loop.

In the mid-frequency range, a flat response was obtained as a result of the combination of the surface induction on the tape which increased at 6 db/octave and the loop response (to constant B_y with increase in frequency) falling at the rate of 6 db/octave as a result of the wavelengths in this region being much less than the "d" dimension (or d/λ large). In this region the output of the loop is a function of $(B_y)(\lambda/2\pi d)$.

In the upper-frequency range, the fall off in the indicated response was caused by the spacing between the loop and magnetic tape. It was, therefore, possible to determine the "d" dimension of the loop and "s," the spacing, from the points at which the response was down 3 db from the flat portion of the curve. With magnetic-coated film (at a transport speed of 7.2 ips), however, the constant-current recording when reproduced did not result in an output vs. frequency characteristic with a clearly distinguishable flat portion. It was, therefore, necessary to determine "d" and "s" by other means. This was accomplished by using the equations for determining "d" and "s" derived in Appendix A. An assumption used in this derivation is that at low-frequencies the normal surface induction, B_y, is proportional to frequency when recording at constant current.

Results

After determining "d," "s," and the voltage output of the loop for a prerecorded film containing a 400-cycle/sec signal, it was possible to calculate B_y using the equations shown above. The loop output which was in the order of 0.1 μv was determined through the use of suitable amplifying and filtering networks to provide an adequate signal-to-noise ratio. This was the same method as used for the work previously reported. Measurements were made on 16mm full-width magnetic-coated film from three manufacturers, using various conditions of bias current and signal level (400 cycles/sec). A total of 13 recorded samples was used. The maximum overall variation in the B_y for any one film was found to be 2.9 db or approximately ± 1.5 db when determined with five different loops. Measurements of B_y repeated with the same loop four times (or for a total of five measurements), however, were found to vary by no more than 1.1 db overall or approximately ± 0.6 db.

Measurements were performed to determine whether the depth of penetration of the recorded signal on magnetic-coated film would have the same effect on the loop output as on the reproduce-head output. The method used was the same as the one described for this test in the previous paper. The changes occurring in loop output were found to be approximately the same as those occurring in the reproduce-head output when changing the depth of penetration.

Tests were designed and performed to determine whether a "fringe effect" occurs when reproducing a magnetic-coated film with a reproduce head that is narrower than the recorded track width. The "fringe effect" is a phenomenon in which the flux existing on the magnetic coating beyond the head width causes an increase in that value of head output that would be obtained when the reproduce head and magnetic track would be of the same width and alignment. Thus, the reproduce-head output would no longer be proportional to the width of the reproduce head. This effect was investigated to determine whether it would be possible to calibrate a tape or film with a nonmagnetic loop, than to use this calibrated tape or film to calibrate a reproduce head. This head could then be used to calibrate any other tape or film depending on which material was used in the primary calibration. This method would be extremely useful for calibrating narrow tracks such as those obtained with magnetic striping on film. The method for determining this effect was as follows:

(A) A 400-cycles/sec signal was recorded on magnetic-coated film with a 138-mil magnetic head. It was then reproduced with the same 138-mil head and a 250-mil head and the output for each case was measured.

(B) A 400-cycles/sec signal was recorded on magnetic-coated film with the 250-mil head. This was then reproduced with the 250-mil head and the 138-mil head and the output was measured. Since the reproduce-head output is proportional to the active head width, 5.2 db was added to the output of the 138-mil head to provide the same 1 : 1 ratio between active head width and track width that was obtained in step (A) for both heads.

(C) The ratio of the two outputs obtained in step (A) was compared to the ratio of the two outputs of step (B).

It was found that the "fringe effect" caused a difference in output of approximately 2 db. This value was verified when a comparison was made of (A) with (B), below:

(A) The output of the 138-mil head when reproducing the 250-mil recording and the B_y of this recording.

(B) The output of the 138-mil head from the 138-mil recording and the B_y measured for this recording.

Conclusions

Measurements made with various magnetic-coated, commercially available films representing the current difference in oxide orientation resulted in the conclusion that the B_y as measured with the nonmagnetic loop is indicative of the playback-head output independent of the oxide orientation that is currently used.

From a comparison of the results in the previous paper and those given above, it can be seen that the values for spacing obtained with magnetic film were greater than those obtained with magnetic tape. The range of values obtained with film were 1.5 to 2.6 mils, whereas with tape the values were in the range of 0.7 to 1 mil. This increase in the spacing was attributed to the fact that the film base is much stiffer

than the tape base and, therefore, there was more of a tendency for the film to bend away from the loop.

It appears that the "fringe effect" encountered with film could be attributed to this increase in spacing. It had previously been found that the "fringe effect" was negligible when using tape. The only major physical difference encountered between the measurements on tape and film was the change in spacing. It appears, therefore, that to be able to use for calibration purposes a reproduce head that is narrower than the recorded track, it is necessary to determine an effective head width which would encompass the additional flux. To date, the Laboratory has not attacked this problem since it was felt that the use of a head width narrower than the track width could be avoided in calibration procedures for measuring absolute magnetic strength.

This spacing effect would also have to be investigated in order to make it possible to use a reproduce head calibrated with one magnetic material to calibrate the signals on another magnetic material. For example, if a head were calibrated with a calibrated magnetic tape, the head could not be used to measure the absolute flux on a magnetic-coated film unless it had been determined that the spacing was the same in both cases.

In the case of magnetic-coated film as well as in the previous measurements with magnetic tape, it had been found that under practical conditions the effect of oxide orientation and depth of penetration were the same for both the nonmagnetic loop and the reproduce head.

A Practical Magnetic-Level Test Film

To facilitate the determination of the audio characteristic of 16mm magnetic equipment, the Society of Motion Picture and Television Engineers was interested in producing a standard magnetic-level test film instead of simply specifying a particular value of surface induction. The Laboratory had indicated that to have such a standard not only would require a standard surface induction, but would also necessitate standardizing the film compliance, track width and track location. It would be expected that variations in compliance would result in variations in spacing loss and, hence, output when reproducing the film on different projection equipment. Variations in track dimensions and location would also result in variations in output among different projection equipment. It was also indicated that magnetic heads of smaller width than the recorded track would possibly deliver an output level greater than anticipated as a result of the "fringe effect."

The SMPTE Magnetic Recording Subcommittee decided to minimize the compliance problem by the selection of a high compliance film base and to standardize the track dimensions and location by using a 250-mil edge track recording for a master film recording. Since the Society had no facilities for performing the absolute level calibration, the Material Laboratory was asked to record a known surface induction (10 gausses at 400 cycles/sec) on a 1200-ft length of film which the Society would provide. The master tape would be used to calibrate the Society's recording facilities and thus provide copies for distribution.

The Material Laboratory provided the Society with this film. In preliminary tests on a section of the film received from SMPTE, a recording level was determined which resulted in an approximate 10-gausses signal on this film when using a 400-cycles/sec signal. The whole reel of film was then recorded at this level. The reel was divided into three sections and each section was carefully calibrated. A calibration sheet enclosed with each reel gave a description of the type of recording and the accuracy of the results. Two sections of the reel were forwarded to the Society for its use and the third section was retained at the Material Laboratory for reference purposes.

Summary of Method

An outline of the nonmagnetic loop method for the determination of the absolute surface induction of a 400-cycles/sec signal recorded on magnetic-coated film is given in Appendix B.

Acknowledgment

This investigation was performed in the Audio Communications Section of the Material Laboratory under the supervision of Frank A. Comerci, Section Head, and Sheldon I. Wilpon, Head of the Sound Recording and Reproducing Unit.

APPENDIX A

Derivation of Equations for the Determination of the "d" Dimension of the Nonmagnetic Loop and the Spacing, "S," Between Loop and Magnetic-Coated Material

The voltage output from a loop is:

$$E = B_y\, vw \left[e^{-\frac{2\pi s}{\lambda}}\right]\left[\frac{1 - e^{-\frac{2\pi d}{\lambda}}}{\frac{2\pi d}{\lambda}}\right]$$

Let this voltage output from loop at wavelengths λ_1, λ_2 and λ_3 be E_1, E_2, E_3, respectively, therefore:

$$\frac{E_1}{E_2} = \frac{B_{y1}\, vw \left[e^{-\frac{2\pi s}{\lambda_1}}\right]\left[\frac{1 - e^{-\frac{2\pi d}{\lambda_1}}}{\frac{2\pi d}{\lambda_1}}\right]}{B_{y2}\, vw \left[e^{-\frac{2\pi s}{\lambda_2}}\right]\left[\frac{1 - e^{-\frac{2\pi d}{\lambda_2}}}{\frac{2\pi d}{\lambda_2}}\right]}$$

Assuming that at low frequencies for a constant current recording:

$$B_{y2} = \frac{\lambda_1}{\lambda_2} B_{y1}$$

then:

$$\frac{E_1}{E_2} = \left[e^{2\pi s\left(\frac{1}{\lambda_2} - \frac{1}{\lambda_1}\right)}\right]\left[\frac{1 - e^{-\frac{2\pi d}{\lambda_1}}}{1 - e^{-\frac{2\pi d}{\lambda_2}}}\right]$$

Similarly:

$$\frac{E_1}{E_3} = \left[e^{2\pi s\left(\frac{1}{\lambda_3} - \frac{1}{\lambda_1}\right)}\right]\left[\frac{1 - e^{-\frac{2\pi d}{\lambda_1}}}{1 - e^{-\frac{2\pi d}{\lambda_3}}}\right]$$

Select $\lambda_1 = {}^1/_2\lambda_2 = 2\lambda_3$

then:

$$\frac{E_1}{E_2} = \frac{e^{-\frac{\pi s}{\lambda_1}}\left(1 - e^{-\frac{2\pi d}{\lambda_1}}\right)}{1 - e^{-\frac{\pi d}{\lambda_1}}}$$

$$\frac{E_1}{E_3} = \frac{e^{\frac{2\pi s}{\lambda_1}}\left(1 - e^{-\frac{2\pi d}{\lambda_1}}\right)}{1 - e^{-\frac{4\pi d}{\lambda_1}}}$$

For simplification let:

$$\frac{E_1}{E_2} = C_2;\ \frac{E_1}{E_3} = C_3;\ e^{-\frac{\pi s}{\lambda_1}} = S;\ e^{-\frac{\pi d}{\lambda_1}} = D$$

then:

$$C_2 = S\frac{(1 - D^2)}{1 - D} = S(1 + D) \text{ or } S = \frac{C_2}{1+D}$$

$$C_3 = \frac{1}{S^2}\frac{(1 - D^2)}{1 - D^4} = \frac{1}{S^2}\frac{1}{1 + D^2}$$

$$C_3 = \frac{(1 + D)^2}{C_2^2}\frac{1}{1 + D^2}$$

$$C_2^2C_3 + C_2^2C_3\,D^2 - 1 - 2D - D^2 = 0$$

Let $C_2^2C_3 = P$

$$D^2 - \frac{2}{P - 1}D + 1 = 0$$

$$D = \frac{1}{P - 1} \pm \sqrt{\left(\frac{1}{P - 1}\right)^2 - 1}$$

$$S = \frac{C_2}{1 + D} \text{ from above}$$

but $D = e^{-\frac{\pi d}{\lambda_1}}$ and $S = e^{-\frac{\pi s}{\lambda_1}}$

Therefore

$$d = -\frac{\lambda_1}{\pi} \ln D$$

and

$$s = -\frac{\lambda_1}{\pi} \ln S$$

APPENDIX B

Outline of Nonmagnetic Loop Method for the Determination of the Absolute Surface Induction of a 400-cycles/sec Signal Recorded on Magnetic-Coated Film

1. Record a magnetic-coated film with signals having a relative surface induction rising 6 db/octave with increasing frequency (as determined by the "short gap" or other suitable method).

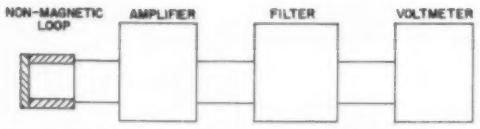


Fig. 2. Block diagram of nonmagnetic loop system.

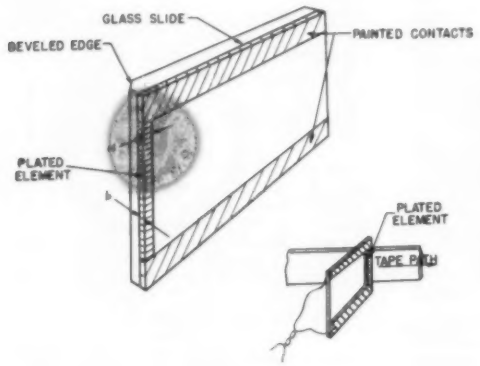


Fig. 3. Sketch of aluminum-plated loop. The sheet of glass was masked to give a "d" dimension of approximately 1/64 in. The plating thickness controlled the "b" dimension (which was less than 1 mil). The glass was plated by the Vacuum Evaporation Process.

Note: Film-base characteristics should be equivalent to film to be calibrated.

2. Reproduce above recorded film using a nonmagnetic loop system similar to that shown in Figs. 2 and 3. Plot output voltage vs. frequency characteristics.

3. Determine the open-circuit output voltages of the nonmagnetic loop, E_1, E_2, E_3, for the respective frequencies f_1, f_2, f_3 where:

f_1 is a frequency of approximately maximum output

f_2 is one octave below f_1

f_3 is one octave above f_1

4. For determination of "d," dimension of loop, and "s," spacing between loop and film, substitute above data in the following equations:

$$d = -\frac{\lambda_1}{\pi} \ln D \qquad (1)$$

$$s = -\frac{\lambda_1}{\pi} \ln S \qquad (2)$$

where:

$$D = \frac{1}{P-1} - \sqrt{\left(\frac{1}{P-1}\right)^2 - 1}$$

$$P = \left[\frac{E_1}{E_2}\right]^2 \left[\frac{E_1}{E_3}\right]$$

$$\lambda_1 = \frac{v}{f_1}$$

v is the film transport speed

$$S = \frac{E_1/E_2}{1+D}$$

5. Substitute into the following equation for determination of absolute surface induction, B_y:

$$B_y = \frac{E}{vw\left[e^{-\frac{2\pi s}{\lambda}}\right]\left[\frac{1-e^{-\frac{2\pi d}{\lambda}}}{\frac{2\pi d}{\lambda}}\right]}$$

where

B_y = surface induction for 400-cycles/sec signal;
E = open circuit output voltage of the nonmagnetic loop for the 400-cycles/sec signal to be calibrated;
v = film transport speed;
w = width of recorded track (to be equal or less than width of the nonmagnetic loop);
λ = wavelength of 400-cycles/sec. signal $= \frac{v}{400}$;
s and d as determined above.

Design of Projection Rooms for German Motion-Picture Theaters

By HERBERT TÜMMEL

Proper projection room design can add a great deal to the technical excellence of motion-picture projection without significantly increasing the cost of the theater. Legal requirements and recommended practices in Germany are described and illustrated in practical detail with the hope that useful comparison may be drawn by projection planners elsewhere.

PROPER PLANNING of projection rooms can contribute much to the quality of the performance. The designs found in existing theaters are often not the best attainable. We shall discuss the important factors and the features required for conformance with the legal requirements of the motion-picture theater law of March 18, 1937, still largely in force in the Federal German states.

Location

The location of the projection room should be decided first. The best conditions for projection occur when the optical axis meets the screen at a right angle. The projection booth should not be off center either vertically, or horizontally (Figs. 1 and 2). Oblique projection creates distortion noticeable by the viewer; the square picture becomes trapezoidal (Fig. 3). To conceal this from the viewer the mask must be moved in—this reduces the picture size (Fig. 4). These conditions must be particularly observed when panoramic or 3-D pictures are presented. A curved screen will show additional distortion (Fig. 5). Though horizontal displacements are often avoided, more or less vertical inclination is frequently found. The projection room cannot always be placed low enough to give a horizontal optical axis.

One good solution is to locate the room just below the balcony (Fig. 6), giving ideal horizontal projection. If this is impossible the inclination should be kept below 10°.

Inclining the screen backwards by an angle corresponding to $\frac{1}{4}$ to $\frac{1}{2}$ max of the angle of projection but not exceeding 6° will be an improvement, although this will reduce the viewer's angle of vision (Fig. 7). Directional and metallized screens should not simply be inclined unless they have been specifically designed for such an installation, since for these screens a tilt changes the light distribution in the auditorium. Positioning the projection room off the center line (Fig. 1) should be avoided at all costs. A small projection angle is already created because both projectors cannot be placed on the center line. Thus they should be arranged symmetrically. With a projection distance of approximately 25 m, which frequently occurs, we obtain for each projector a projection angle of about 2°, which with shorter distances becomes bigger and with greater distances smaller. Indeed this angle is rather small, but with short projection distances and wide screens it may have some influence.

Size

German regulations decree a minimum floor area of at least 64 sq ft (6 sq m) for a booth with one projector, with a minimum length of 6.5 ft (2 m) and a minimum width of 9.2 ft (2.8 m). The ceiling at the projectionist's position must not be less than 6.5 (2 m) high. For every additional projector the floor space must be increased by at least 32 sq ft (3 sq m)—a two-projector booth must therefore have at least 96 sq ft (9 sq m) area. All these are minimum dimensions. To allow unobstructed work do not skimp on space. Instead of 96 sq ft (9 sq m), provide for at least 215 sq ft (20 sq m) because much new equipment (e.g. CinemaScope) has been added. The front wall containing the portholes should be at least 13.1 ft (4 m) wide and the room at least 9.8 ft (3 m) deep. Minimum free height should be 8.2 ft (2.5 m) and air space 1320 cu ft (37.5 cu m). These are dimensions for two motion-picture projectors and one slide projector. For every additional piece of equipment (projector, spotlight, still

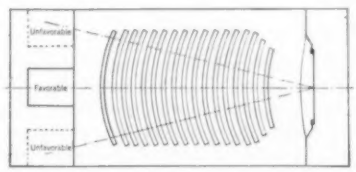


Fig. 1. Location of the projection room in a horizontal plane.

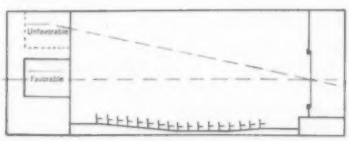


Fig. 2. Location of the projection room in a vertical plane.

Fig. 3. Distortion created by oblique projection on straight screens: left, distortion from above; center, distortion from one side; right, horizontal projection.

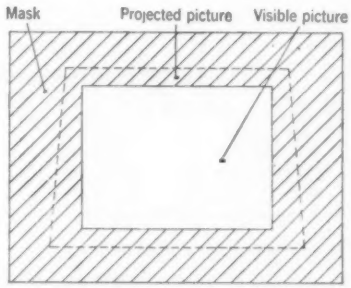


Fig. 4. Projected picture and mask with oblique projection from above.

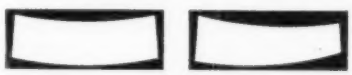


Fig. 5. Distortion from oblique projection on curved screens: left, from above and, right, from side and above.

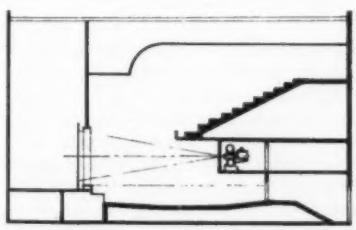


Fig. 6. Horizontal projection with projector located below balcony.

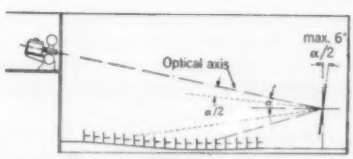


Fig. 7. Oblique projection with tilted screen.

A translation, with additions, of an article published in the *Zeiss Ikon Bild und Ton*, No. 44, November 1955. Dipl. Ing. Tümmel is an engineer at Zeiss Ikon AG, Kiel-Wik, Mecklenburgerstr. 32–36, Germany. Translation is by Paul K. Voltaire and Fred T. Schick, General Precision Laboratory Inc., Pleasantville, N.Y. Editorial assistance has been contributed by Chauncey L. Greene, 4852 Drew Ave., South, Minneapolis 10, Minn.

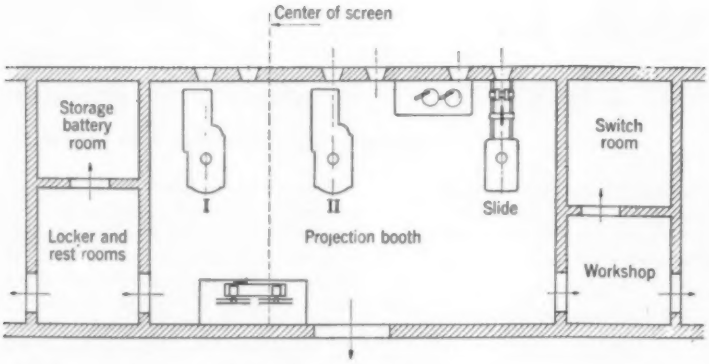


Fig. 8. Projection booth with additional service rooms.

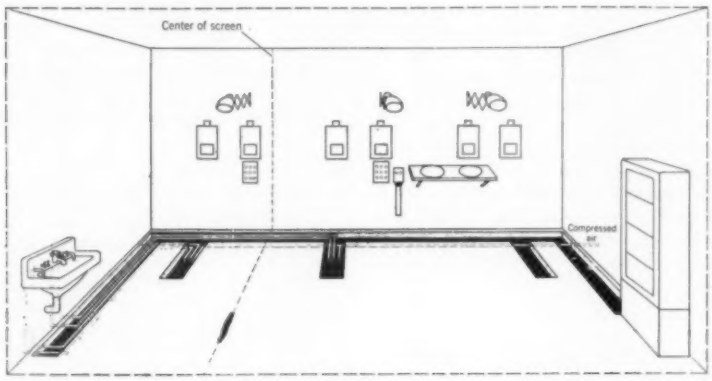


Fig. 9. Arrangement of cable ducts.

projector) the floor space should be increased by 54 sq ft (5 sq m).

The cost for an adequately large projection room which also offers possibilities of enlargement in the future does not play any decisive role in the entire construction budget. If we compare the volume of the auditorium with that of the projection booth, this becomes evident. An auditorium for 600 persons covers an area of about 3200 sq ft (300 sq m) and a height of 23 ft (7 m), thus having a volume of 74,000 cu ft (2100 cu m). A projection booth of regulation size is 29.5 × 9.2 ft (9 × 2.8 m), which is 890 cu ft (25.2 cu m) in volume — only about 1% of the auditorium.

In larger theaters the ratio of projection room area to auditorium area is far less than 1%. Increasing the size of the projection booth by two or three times cannot substantially affect the total cost. Therefore before construction or reconstruction is undertaken the projection booth should be planned in such a way that working conditions are as good as possible and new projection or sound systems can be added without great difficulty.

The width may be reduced by using an attachable slide unit. The front wall must be 10 in. (25 cm) thick if of brick, or 4 in. (10 cm) thick if of reinforced concrete; it must have no open connection with the auditorium. Even ducts for electric cables must have smoke-tight seals.

Projection Booth Windows

The portholes must be smoke-sealed by glass plates at least 5 mm thick and must be equipped with steel slides of 2 mm minimum thickness. The projection ports must be no larger than necessary to pass the light rays. The viewing ports may have a maximum area of 39 sq in. (250 sq cm). Porthole positions depend on both projector height and angle. Projection and viewing ports are no longer placed at different heights but on the same level. The projectionist should be able to sit down and yet have complete command of his work.

Exact information about port location should be obtained from the suppliers of the projectors. Since the light rays fill the projection port almost completely, some might be cut off when projecting CinemaScope. Fortunately the rays do not spread out immediately after passing the anamorphotic adapter but spread several centimeters after it. At normal focal lengths the rays will not be obstructed by a normal port, if the projectors are not too far away. In most cases the flare-out of the wall at the port opening will also be sufficient. The width B of the wall opening may be estimated from:

$$B = \frac{5d}{f} + 10$$

where

B = width of wall opening in cm;
d = distance in cm from front lens of objective to auditorium side of wall;
f = focal length of objective in cm.

e.g. $d = 50$ cm, $f = 10$ cm, gives $B = \frac{5 \times 50}{10} + 10 = 35$ cm.

Additional Rooms

Adjacent to the projection room is the "switch room," containing all equipment not continuously operated during the show, such as the rectifiers for the arclamps and the switchboard. A battery room is needed for emergency storage batteries and, if possible, there should be a small workshop for the projectionist (Fig. 8).

Cable Ducts

Numerous cables are required for all the equipment, and cable ducts (Fig. 9) should be planned; they should lead right up to the projector bases, an arrangement which facilitates changes and trouble shooting. Feed and drain pipes for water-cooled projectors as well as compressed air lines may be located in them.

A basic diagram of the electrical system is shown in Fig. 10. A permanent connection between the rectifier or motor generator and its respective arclamp is inadvisable; instead a switching system should be used whereby each rectifier or motor generator can work with each arclamp or arclamps can be connected in parallel so that if one rectifier or motor generator fails, the associated projector can nevertheless be operated. The electrical installation must comply with VDE regulations 0108/XII 40.

Sound Insulation

Transmitting noise to the auditorium must be guarded against when planning projector placement. If the front wall of the booth is built according to regulations it will probably be acoustically adequate. Transmitted noise can be eliminated by keeping the projectors off the steel building beams. They are best installed on concrete pedestals resting on sound-insulating material. If this is impossible, the projectors themselves should stand on an absorbent material (cork, rubber, felt, etc.), and the floor-anchored hold-down bolts must be insulated from the projector bases (Fig. 11).

In a similar way the rectifiers, the compressor and the rewinds are insulated (Fig. 12), since they too produce noise. A certain amount of noise may be produced by the equipment, by the film running through the projectors and the voices of the projectionists. If this sound is not too loud, it is usually absorbed by the

massive walls of the projection booth. Openings in the booth are frequent weak points, and in any case the windows should be well mounted in felt or similar material (Fig. 13). In particularly difficult cases it is advisable to use double glass windows. Resonance in the projection booth can be minimized by lining the ceiling and upper parts of the walls with sound-absorbent material. The sound of the steps of the projectionists which could be annoying in the rooms below the projection booth can be diminished by a soft floor (linoleum, etc.) or by sound-insulating material placed in the floor.

Ventilation and Heating

If the smoke vents which are needed with arclamps are badly designed, they will have poor aerodynamic efficiency and poor draft and will subject the two lamps to unequal suction. If separate vents are impossible, the main pipe should not be horizontal, but should slant upward and the diameter should be larger than each of the two individual ducts.

Good lamps have dampers for individual draft control mounted on their housing; if not, each exhaust pipe should have a damper installed to prevent unsteady arc burning. If structural reasons demand a very long exhaust duct having little upward slant, a small suction fan will permit sufficient exhausting of combustion gases.

Since the arclamps and other electrical equipment in the projection booth convert about 2 kw of electrical energy into heat, sufficient general ventilation and fresh air supply must be provided. Heat generation and oxygen consumption are more critical and bothersome in a small projection booth than in a big one. Even though heat is developed during operation, the projection booth should be provided with a heating system. This is essential during the cold season. Even a small amount of heat is not only a comfort for the projectionist, but it also protects the valuable equipment against damage due to corrosion and assures a perfect start of the projectors by keeping the oil freely flowing.

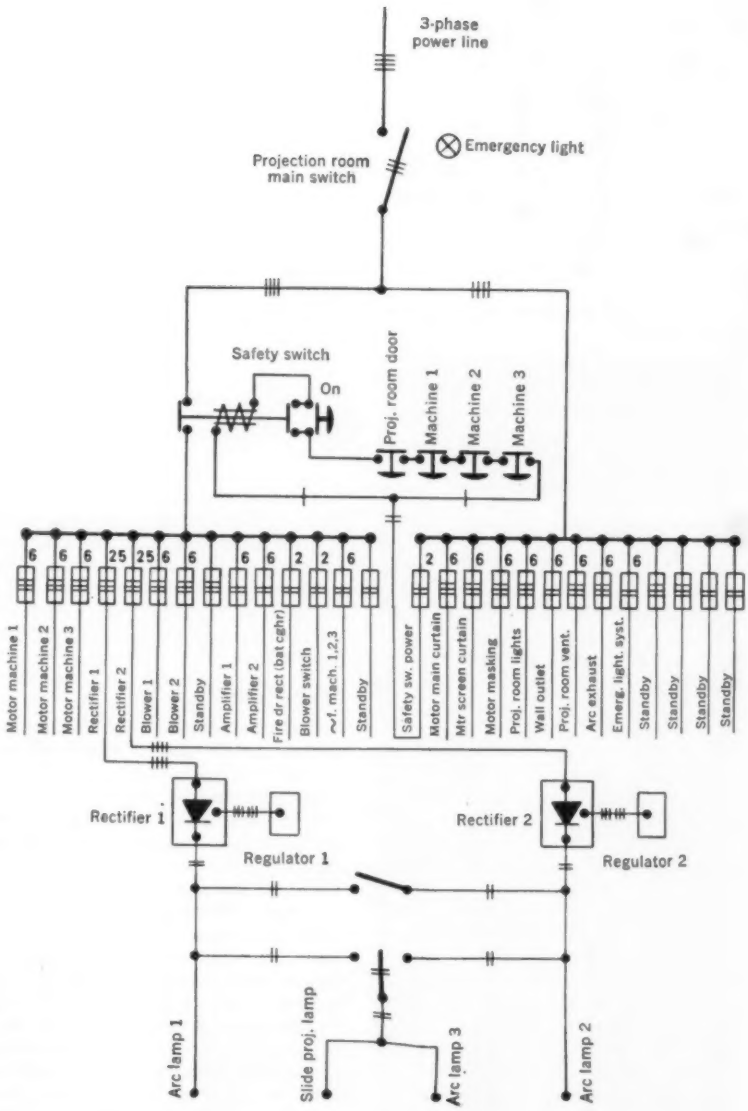


Fig. 10. Basic schematic diagram for projection booth.

Color and Lighting

The projection room should be painted in a light color but not light enough to reflect stray light unpleasantly; a medium hue with an absorption factor of about 50% should be proper. The paint or any other furnishings must not give off dust since it endangers both the valuable equipment and the sensitive film.

A movable light fixture should be mounted near each projector to enable the operator to get light as needed and swing the fixture out of the way after use. Incandescent bulbs protected by glass bells or wire cages should be used for

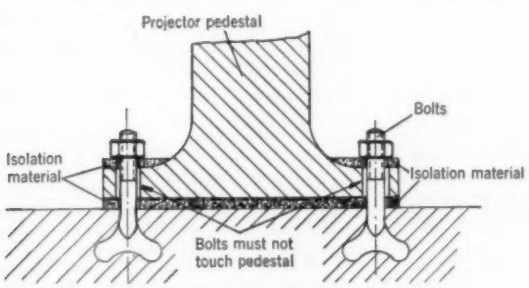


Fig. 11. Sound insulation of projector pedestal.

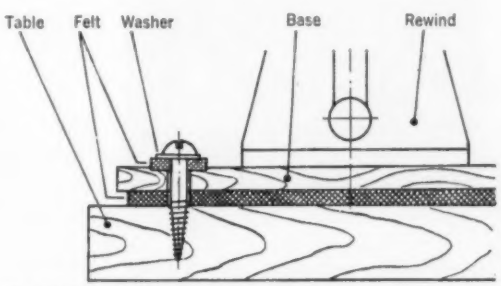


Fig. 12. Sound insulation for rewind.

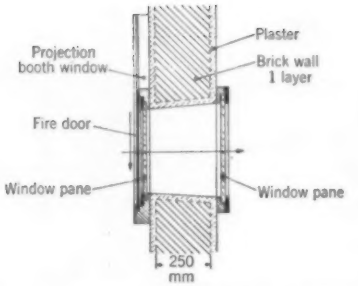


Fig. 13. Sound insulation of projector booth window.

booth illumination. Sufficient outlet boxes, especially in the workshop, should be provided.

Fire Protection

Projection room windows and doors should be protected by fireproof panels. These should project 20 in. (0.5 m) and overlap the openings on both sides by 12 in. (0.3 m). They are not needed if there are no combustible building materials or windows above or on the sides.

Air pressure created by a fire must be relieved quickly by an explosion vent which opens easily and automatically. It may be in a connecting room, must have an area of at least 2.7 sq ft (0.25 sq m) and may be of ordinary window glass. Since it must have no latches, burglary may be prevented by a grating. A water outlet in the projection room is desirable; it helps the operator and is necessary for water-cooled projectors.

Arrangement of the Equipment

Constantly operated equipment (gong, house dimmer, turntable, curtain control, remote control switches, etc.) should be positioned close together, preferably, for operation from the work position. The monitor speaker should also be near this position for monitoring the sound without machine noise interference. Equipment used only at beginning and end of the show (blowers, rectifier, amplifier, etc.) should be farther away or in an adjoining room. The rewinding equipment, which is much used, should, however, be at a safe distance from the arclamps as a fire precaution (in Germany at least 4.9 ft (1.5 m)). The film case is located suitably near the rewinder, preferably above it, for accessibility.

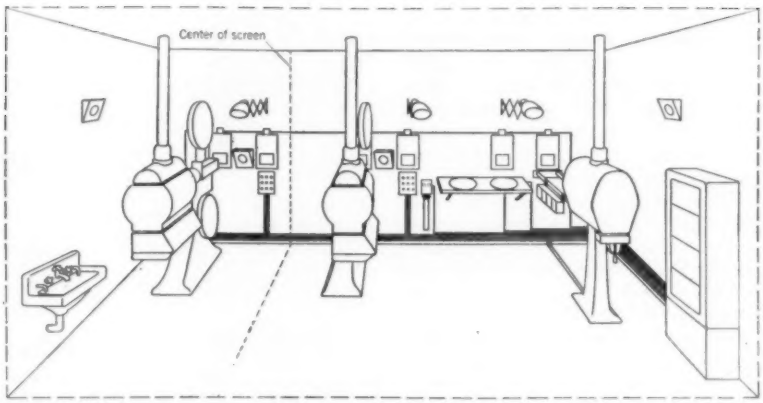


Fig. 14. Arrangement of equipment in the projection booth.

Loudspeaker

Each projector should have a control loudspeaker of its own, which is mounted so that it is close to the projectionist's head. This enables the projectionist to test for sound and judge the quality. But if the control loudspeaker is placed too far away, the projectionist not only hears the direct sound, but also that reflected to a great degree by the walls. Furthermore, the loudspeaker must be turned up higher because of the greater distance and so as to sound louder than the disturbing noise of the projector room. Usually with these systems under such conditions, distorted reproduction results.

With multichannel sound and the need to monitor reproduction from several channels it is not at all advisable to control the additional channels by switching them at random to the control loudspeakers of the main channel. That is patchwork. Each channel should have a control loudspeaker of its own. The main channel (in CinemaScope it is channel 2) is consequently fed to the same loudspeakers used for a one-channel system, i.e., the two control loudspeakers closest to the projectionist's working area. The additional control loudspeakers for channel 1 are mounted on the left, for channel 3 at the right, and for channel 4 in the back (Fig. 14). This setup offers the advantage that the projectionist can very accurately hear (tune in) the important channel 2. He can watch over the working of the three other channels because of the space distribution of the control loudspeakers. It is not advisable to place the four control loudspeakers closely together, i.e. on a common board. In this case the projectionist can hardly establish which of the loudspeakers or channels is working.

The modern projection room is roomy and airy. The equipment is well arranged in it or in adjoining rooms (Fig. 14); therefore the projectionist can devote himself completely to his work and can concentrate on producing good picture and sound reproduction.

A High-Intensity Electronic Light Source for High-Speed Cameras

By WILLIAM C. GRIFFIN

This paper compares various methods of obtaining a series of reflected light photographs of projectiles penetrating metallic plates. Illumination for high-speed photography has been provided by the argon flash, photoflash lamps, flash powder, carbon arcs, incandescent sources, electronic flash and other means. The electronic flash generally has advantages over other methods. However, the shape of the light pulse is far from uniform. A method of shaping the pulse of light is described.

VARIOUS METHODS of photographing high-speed projectiles have been tried with varying degrees of success. To obtain satisfactory terminal ballistic photographs of projectiles it is necessary that the film motion be synchronized with the movement of the image, or that the camera track the object, or that the exposure time be very short in order to reduce image motion to a degree that is not objectionable according to the data reduction requirement.

The synchronization of film speed with image movement may be accomplished with the Warrick, Fastax and other streak cameras. This method is satisfactory where a single picture is required along the trajectory. A picture of the target or of images moving at other than synchronized speeds is not obtained. The tracking technique is a good method where the distances are great and the angular tracking velocity low. Such systems are used on our M-45 camera mounts and Askania cameras as well as with hand-operated cine cameras.

The method using a very short exposure, with or without image compensation, presents several problems. The most difficult of these is that of obtaining adequate illumination for reflected light photographs at very high framing rates and exposure times of 10 microseconds or less for a sufficient number of frames to cover the area of interest. For this purpose the high-intensity electronic light source is herein described.

Description

The gaseous discharge tube, often called the "Edgerton Flashlamp," is generally used as a high-intensity, short duration (1 to 200 microseconds) light source. In our application the peak intensity has been reduced and the duration increased. The form of the light output curve is of a generally square shape as illustrated in film B of Fig. 1. The duration of reasonably uniform level is approximately 2.5 milliseconds whereas in the unmodified circuit, film C, reasonable uniformity of exposure is obtained for only 0.60 milliseconds. The intensity of object illumination by this method has been proven in the field to be adequate for small scale penetration studies with high-speed framing cameras. An 8mm Fastax Camera at framing rates to 18,000/sec and a lens aperture of $f/32.0$ has been used successfully in this work.

Figure 2 illustrates the present use of the light as an aid to the study of the phenomenon known as plate (target) flash. In this photograph the framing rate was approximately 16,000/sec. The camera was fitted with 0.115-in. aperture plate and the lens aperture set at $f/32.0$. The projectile velocity was approximately 3000 ft/sec and the thickness of the 24 ST aluminum target plate was $\frac{3}{8}$ in. Under similar conditions but without the high-intensity light we would have only a photograph of the flash following impact.

Figures 3 A, B and C show microdensitometer records made from the negatives of Fig. 1. Curve B is a record of the light output as seen by the Fastax Camera at 15,500 frames/sec. The circuit for forming this "square" light pulse is illustrated in Fig. 4. Curve C of Fig. 3, is a "normal" flash circuit with the same value of capacitance, and curve A is an earlier attempt at shaping the light output curve. The photographic superiority of the more uniform output of the shape pulse of curve B is evident in the film records of Fig. 1.

Conclusion

1. The light described here is very helpful in this type of photography. Details of the picture area ordinarily lost because of inadequate lighting are obtained with the aid of the high-intensity light.

2. There is considerable latitude available for lens aperture or exposure-time change as strong negatives are obtained at $f/32.0$ with an exposure of approximately 10 microseconds and a lamp to subject distance of 12 ft.

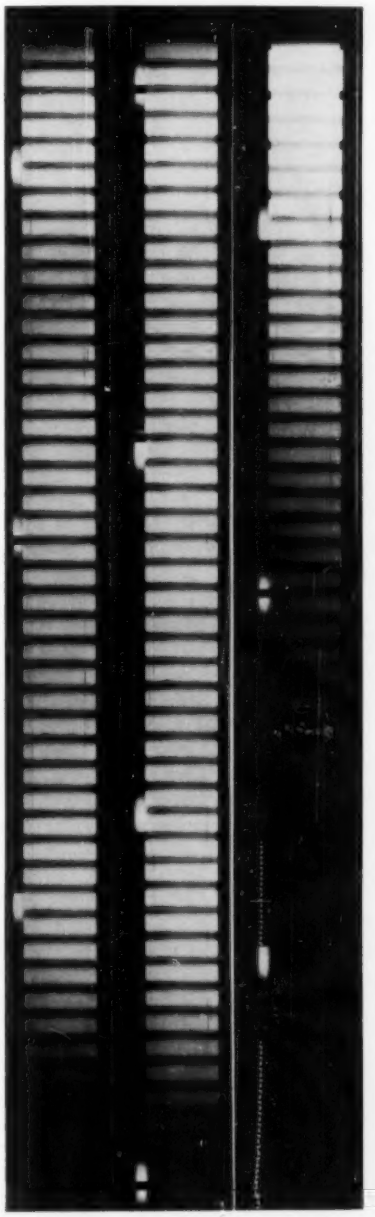


Fig. 1. Form and duration of light output using Edgerton Flashlamp.

Presented on October 10, 1956, at the Society's Convention at Los Angeles by William C. Griffin, U.S. Naval Ordnance Test Station, China Lake, Calif. This paper does not necessarily represent the official views or final judgement of the Naval Ordnance Test Station, and the Station assumes no responsibility for action taken on the basis of its contents.

(This paper was received on September 24, 1956.)

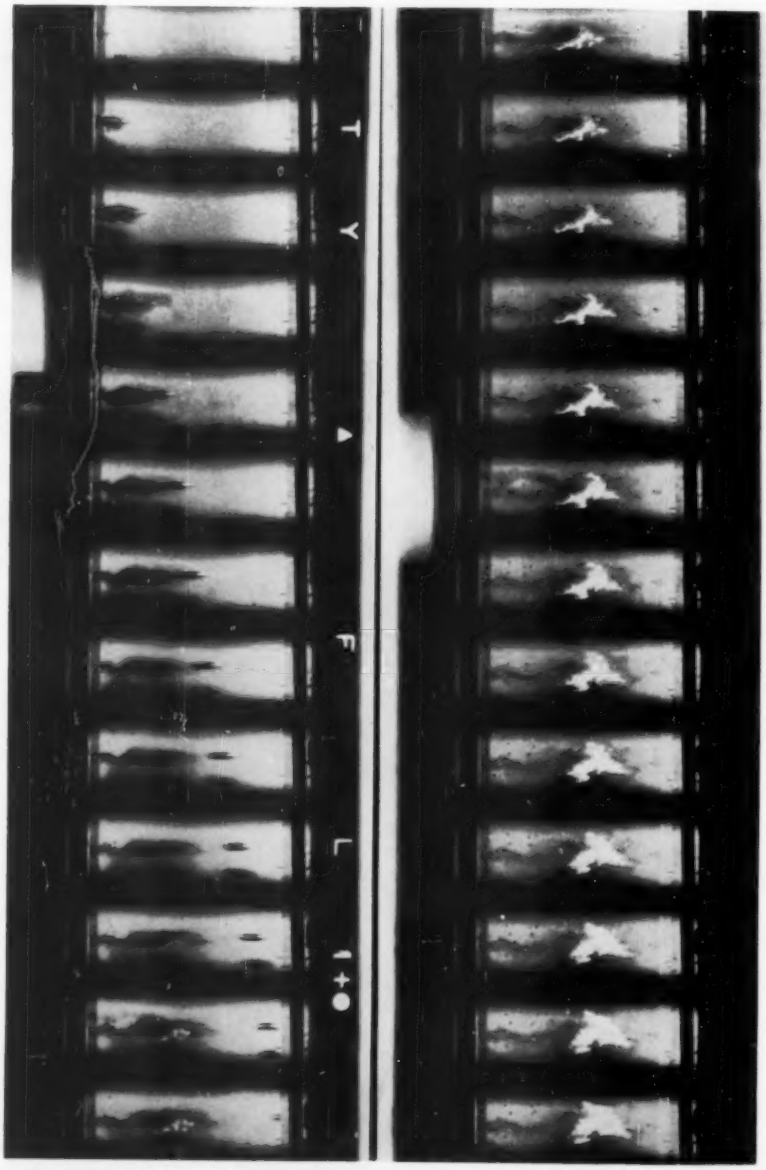


Fig. 2. Use of the light as an aid to the study of plate (target) flash.

3. It is planned to construct a new unit that will provide eight times the output of the present unit. With this unit reflected light photographs with the ultra-high-speed rotating mirror framing cameras or with cameras using electro-optical shutters will be practical as field instruments for the photography of projectile break-up, penetration and other phenomena.

Acknowledgments

It is a pleasure to acknowledge the assistance of James Oestreich of the Metric Photographic Branch, Test Dept., who planned the timing system and made the microdensitometer records, and of Marvin Backman of the Warhead Research Branch, Propellants and Explosives Dept. who provided the range facilities for the field tests of the instrumentation.

Discussion

Lincoln L. Endelman (Convair, San Diego, Calif.): Did you make a comparison between a xenon and argon source or did you use strictly xenon sources? The FT-24 is, I believe, a xenon-filled lamp. Did you try an argon filled lamp?

Mr. Griffin: We used commercially available lamps. The G.E. Lamp was found to be a good item; that is the one we worked with.

Mr. Endelman: About how many lumens did this lamp put out when stepped down?

Mr. Griffin: A level of approximately 42,500,000 lumens is provided.

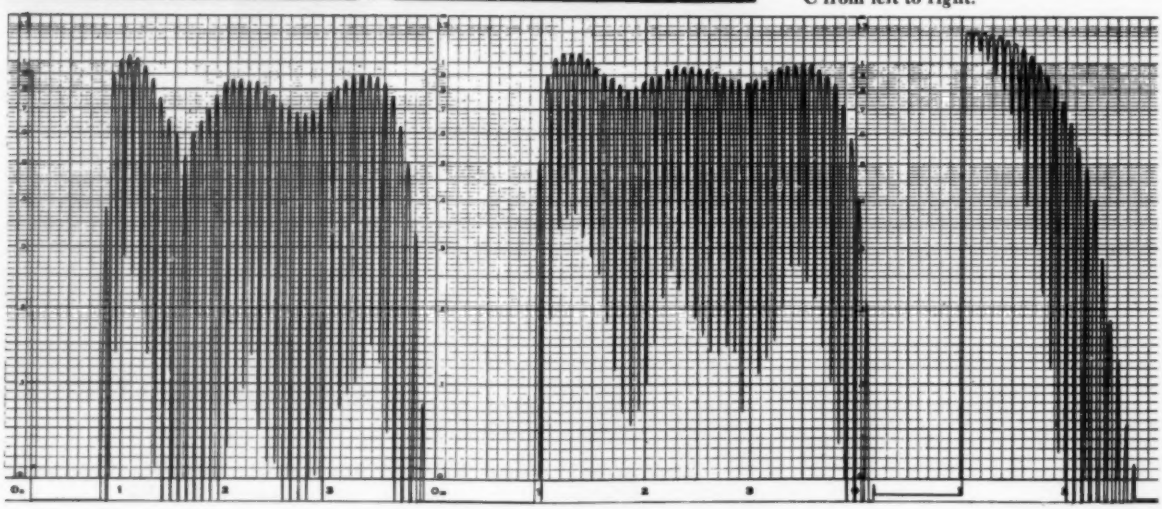
Lt. Fred F. Meadows, Jr. (Ballistic Test Facility, AFAC, Edwards, Calif.): What might be expected as the minimum rise or fall time of a fairly high intensity electronic light source of this type.

Mr. Griffin: Are you speaking of the long duration source or a very short duration source?

Lt. Meadows: Well of either source, long or short. I'm talking about the rise or fall time, the duration is not of great significance.

Mr. Griffin: The resistance and inductance of the circuit are factors. If you will notice on the graphs — the rise time, in approximate millisecond intervals, is quite short, a matter of

Fig. 3. Microdensitometer records made from negatives of Fig. 1. Parts A, B, and C from left to right.



approximately 1 frame at 15,500 frames per second. The drop-off time is greater. As the resistance of the circuit is increased, it becomes more and more difficult to hold the circuit square. For a unit of high power the rise time is short, a matter of approximately 65 microseconds.

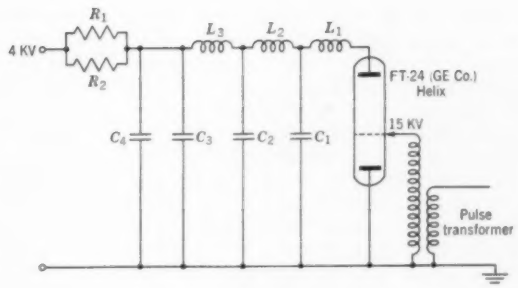


Fig. 4. Circuit for forming "square" light pulse of 2.52 msec. *Note:* **The FT-24 flashtube is of helical construction and is drawn as a straight tube for simplicity.**

R_1 R_2 = 1000 ohms, 200 w
C_1 = 80 μf 4 kv, GE = #14F204
$C_2C_3C_4$ = 100 μf, 4 kv, GE #14F311
L_1 = 0.90 mh, #10 WG
L_2 = 1.22 mh, #10 WG
L_3 = 1.58 mh, #11 WG

Requirements for Cameras in Guided Missiles

By ROBERT M. BETTY

Foreword—by Carlos H. Elmer, U. S. Naval Ordnance Test Station, China Lake, Calif.: While enjoying the privilege of serving as Chairman of a session on Instrumentation and High-Speed Photography during the Society's 80th Convention in Los Angeles, I introduced Mr. Betty's paper with the observation that such an analysis of guided missile instrumentation was long overdue to meet a great need of the workers in the field.

Strictly speaking, this is not a technical paper, but rather a general report on the development of a new field of optical instrumentation, accompanied by a sobering statement of the problems that are still to be solved. In this respect, it resembles in many ways the valuable examination made by John A. Maurer in "Technical Opportunities in the 16mm and 8mm Fields" in the November 1956 *Journal*. Such papers (or technical editorials) are of great value in that they stimulate the imaginations of the members of the Society and produce new ideas and solutions. The importance of the guided missile program described by Mr. Betty is such as to deserve the attention and assistance of the Society's members in the solution of the many new and unusual technical problems confronted in our defense effort.

While missiles of various types have been known for centuries, the existence of a missile industry dates from the German V-1 and V-2 programs of the last war. The years following the end of that war saw this nation and others continue work based in part on German experience. Information gained in this manner, plus increased world tensions, resulted in greatly expanded research and development programs only a few years after the conclusion of World War II. Today, we find ourselves at the beginning of what might become one of the largest research, development and production programs ever attempted by man.

This program contemplates speeds that seemed completely unrealistic only a short time ago, making the role of the thermodynamicist one of the most vital ones in the development team. Accomplishments of propulsion people and structures engineers have charted paths around obstacles that had once seemed unsurmountable.

This is the day of the intercontinental guided missile and the earth satellite. In the center of these developments lies Instrumentation — Instrumentation of a type and versatility and complexity not imagined a few years ago.

Yesterday was the day of conventional, manned aircraft, operating in an environment that placed few unusual demands upon instruments. The Gun Sight Aiming Point camera, or GSAP, was advertised as a model of compactness, durability, reliability and optical perfection. While these cameras appear woefully inadequate for today's requirements, they did serve a purpose, and are still used today. These cameras were usually programmed by intervalometers, some of which did not work even as well as the GSAP cameras themselves. Lenses for these cameras were generally manufactured under rush conditions, and quality was not too good, although later lenses were greatly improved. In those days, 64 frames/sec was usually adequate, and a 1/500- or 1/1000-sec exposure could stop most motion. Problems of film grain and color fidelity were troublesome, but we were somehow able to obtain the desired results. While the term "Instrumentation" was only loosely applied to these cameras and timers, their reliability and performance were acceptable for that time.

The Missile Program

Suddenly we were in the missile business in a big way. Not only was it necessary to develop the missiles themselves, but there had to be built up a complete new art in the use of telemetering, optics, transducer systems, beacon and command systems, and data gathering and transmission devices — items that truly deserved the title "Instrumentation." Time was a most precious commodity, and there never seemed to be enough of it. Frantic timetables were accompanied by environmental demands that were appalling, including such operating conditions as temperatures ranging up to 1000 C, 100-G constant acceleration, vibration accelerations from 20 to 2000 cycles/sec with loads in the 10- to 20-G range, and shock loads of up to 400 G without damage to equipment. Timing requirements and exposure times have changed from milliseconds to microseconds, and millimicroseconds are actually used in some computations. Flight times have changed from a few

Presented on October 10, 1956, at the Society's Convention at Los Angeles by Robert M. Betty, Lockheed Aircraft Corp., Missile Systems Div., 7701 Woodley Ave., Van Nuys, Calif.
(This paper was received on February 7, 1957.)

seconds to hours, and when we speak of satellites, we speak of flights that might last years.

To apply these conditions to more familiar examples, consider that the 100-G constant acceleration would cause disintegration of a B-36 bomber. The vibration just mentioned would tear the rivets out of the chassis of any automobile and remove the cylinder head without the help of a wrench. The temperature would melt all the solder connections in a television set, boil away all the thermoplastics, and reduce to cinders all wiring insulation. The shock loads would wrench the engine from a car, taking the radiator and grille with it. Lower temperatures, down to minus 65 F, would freeze all lubricants, including crankcase oil, into one solid block. In the case of a radio in operation, effects from some of these environmental influences would obliterate all transmitted signals.

Since the extremes of these environmental conditions come into play within a matter of seconds, we face many problems. For the first time, so far as I am aware, an industry has suddenly found most of its existing equipment almost totally obsolete.

Because photographic instrumentation people initially lacked money and time, they attempted to meet demands by using war surplus equipment. GSAPs were modified to stand as much environmental pounding as possible, while equipment manufacturers were encouraged to undertake developments on their own to meet foreseeable needs. The improvisations and "field expedients" of the optical instrumentation people began to deliver results, while the far more complex electronic systems, struggling to keep abreast in their own rapidly expanding fields, demanded more time. The result has been a greater and greater dependence upon optical instrumentation, which has resulted in vastly increased budgets for development and procurement of truly adequate optical instruments.

Equipment manufacturers have begun to answer the calls for help, with the result that today there are at least two cameras which can satisfactorily meet most of the environmental conditions. Other suppliers are moving with great speed in providing programmer systems that will perform satisfactorily. These developments achieved by optical instrumentation firms have helped reduce the pressure on the missile firms now free to devise their own instrumentation.

Miniaturization

While reliability of operation lies at the heart of the problem, another factor is also of great importance. This is the requirement for miniaturization. As stated by one rather pessimistic instrumentation man: "Make it rugged enough to function satisfactorily inside a furnace or at the South Pole — hit it with a sledge hammer on an anvil — fire it from a battleship's gun — no matter how good it is or how perfectly it works, it is useless if it cannot be squeezed into the size of a walnut." While some people assume that a modern guided missile is merely "an overgrown skyrocket with fins on it," nothing could be further from reality. The missile, big as it might be, is crammed, jammed, and crowded through every cubic inch of available space with equipment and instrumentation numbering thousands of components. During the missile's development stage, high-explosive warheads give way to instrumentation warheads, for these test vehicles must gather data if their purpose is to be fulfilled.

As miniaturization of data-gathering devices takes place, the space thus saved tends to be filled with other instruments to meet the never-ending demand for more data. Minimum camera sizes have generally been governed by the space required by film. While the development of Cronar film base permits an appreciable reduction in film space, this space is still a matter of concern. It appears that an intense program of optical instrument miniaturization must be undertaken to keep in step with advances made in electronic data-gathering and transmitting systems for guided missile use.

The Immediate Future

It is easy to make the general assertion that we must design for the future. Let us look for a moment, however, at the requirements which must be met in a very short time — say in the next year, or next two years at the most.

A camera must be developed which is much, much smaller than any which is designed around a load of film, either conventional film or film with a thin base. The optical system of this camera must be capable of resolution equal to, or superior to, that of today's. This camera must be capable of withstanding the severe environmental conditions mentioned previously; and it also must operate dependably and efficiently under even worse conditions — constant accelerations of 200 or even 400 G, infernos of *more* than 1000 C at the front vertex of a lens system, while at the same time an element of a lens may become luminous because of the thermodynamic conditions imposed upon it. And all of these problems must be overcome while the giant hand of environment is shaking this instrument with the fury of Mach numbers never before encountered. It might be thought that this is so utterly impossible as not to warrant serious discussion. Yet, intensive studies are now being conducted by companies both within the missile business and within the industry of optical instrumentation which will lead to the design of precisely such cameras and lenses.

Optical transducers used as high-frequency vibration pickups, strain gauges, and the like, must be made available to record frequencies substantially in excess of 20,000 cycles/sec. Current theory and practice give promise that this goal will be met.

Anamorphic lens systems providing aspect ratios as high as 500-, or even 1000-to-1, might provide positioning devices, navigational devices, and data-gathering systems that are far more accurate than any now in use.

Optical sensing equipment for control of camera framing rate is needed. The equipment must be capable of responding to changing conditions noted in the field of view covered by the camera, such as a change in intensity of light, a shift of color, or the movement of a missile component past certain specified limits. This field is being intensively studied. Other automatic controls are needed for changing focal lengths of lenses in flight, and for control of aperture openings and focus.

Eventually we must place great reliance upon images televised from missiles in flight, a subject under study at the present time by both missile manufacturers and by members of the television industry. Scanning frequency rates must be multiplied, transmission quality must be improved, transmission ranges must be greatly enlarged, and picture resolution must become more competitive with that obtained by film recordings made in the missiles.

It would be difficult in looking back to find much support in the scientific fraternity for the belief that man would place a satellite in space during this decade. Yet it appears that this may be accomplished. Such an achievement will be possible only because workers in the sciences and in engineering have been able to draw upon a reservoir of new conceptual schemes, and of new ideas.

Lee A. DuBridge has very ably pointed out that "Ideas cannot be manufactured like automobiles on a production line. Ideas arise in the brains of individual people, and they arise under circumstances which no one — not even the individual himself — fully understands."

The field of missile instrumentation needs such new ideas today.

Third International Congress and Other High-Speed Photography Activities

By RICHARD O. PAINTER

SIXTY-TWO PAPERS were presented at the Third International Congress on High-Speed Photography, to report advances since the first and second international symposiums. New techniques, new developments and new applications were reported and described.

The Third Congress was held at the New Government Offices, Whitehall Gardens, Horse Guards Ave., London, September 10–15, under the sponsorship of the British Government's Department of Scientific and Industrial Research.

The first International Symposium on High-Speed Photography was sponsored by the SMPTE and held at Washington, D.C., in October 1952. The Second International Congress was held in Paris in September 1954.

The Third Congress brought together leading authorities in the field. Approximately 330 delegates were present. Countries represented included the United States, England, France, Germany, Switzerland, Belgium, Holland and Japan.

The official opening took place Monday, September 10, when Sir Owen Wansbrough-Jones declared the conference in formal session. The opening address was delivered by Prof. P. Naslin, Laboratoire Central de l'Armement, Paris. The Congress was presided over by B. K. Blount, acting for Prof. H. W. Melville, Secretary of the Department of Scientific and Industrial Research, who was unable to be present.

The Exhibition was officially opened by Lord Brabazon of Tara. Twenty-eight manufacturers and distributors displayed high-speed photographic equipment.

The Sessions on Monday morning and afternoon were on flashlight sources. Chairman of the morning session was Prof. H. E. Edgerton, Massachusetts Institute of Technology, U.S.A. Chairman of the afternoon session was Prof. J. M. Meek, University of Liverpool.

The papers presented were roughly in two main groups: techniques, and applications, with the larger number concerning techniques.

One lively session covered application to ballistics and explosives and separate sessions were given to aerodynamics and hydrodynamics. One paper was presented on application to biology, "Applications of a Flash Cathode-Ray Tube to the Study of the Circulation in Live Tissue" by A. M. P. Brookes and P. A. G. Monroe, University of Cambridge.

A general idea of the attendance at the sessions may be gained from the

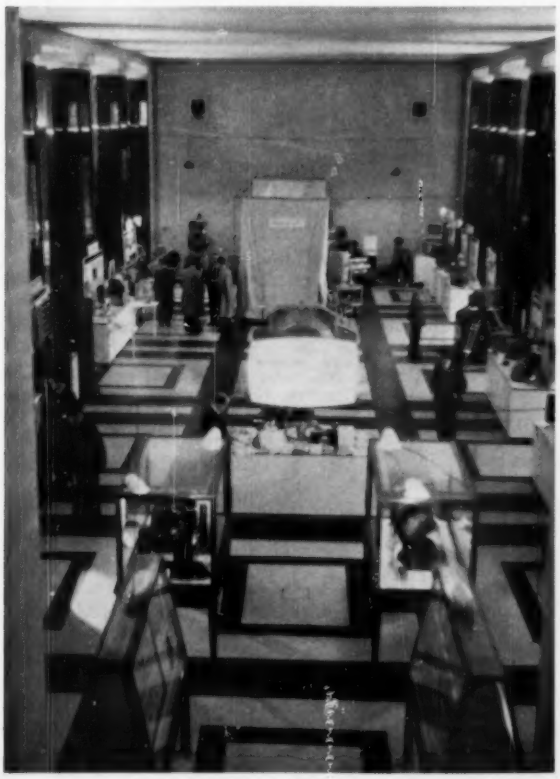


Fig. 1. General view of exhibition hall, which housed 25 commercial and governmental exhibits of high-speed photographic equipment, plus interesting historical exhibits.

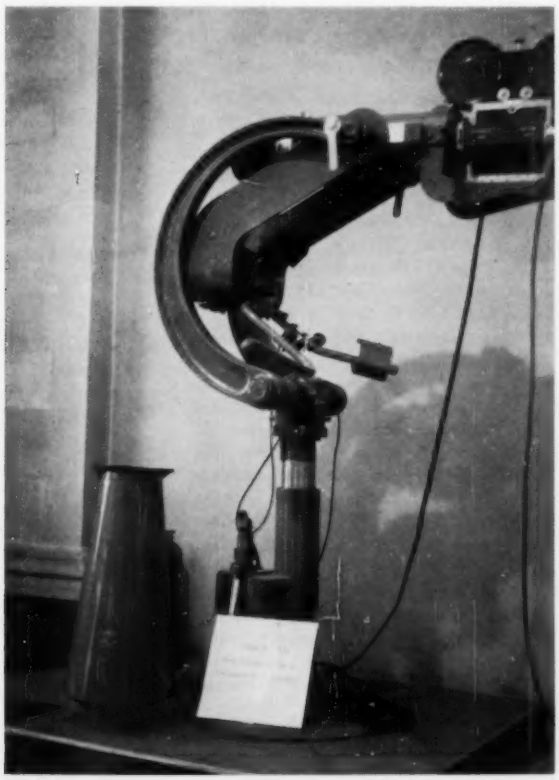


Fig. 2. Vinten High-Speed 300 Camera fitted to tracking mount used for guided missile photography at the Royal Aircraft Establishment, Aberporth.

Fig. 3. High-Speed cameras used by Dr. Lucien Bull in 1904. Dr. Bull, of the Marey Institute in Paris, is still active in high-speed photographic work, and was an honored member of the Congress.

Fig. 4. Exhibit by the Royal Aircraft Establishment of wingtip pods for Firefly drone target aircraft which contain four high-speed cameras with wide-angle optics, each recording a 142° field of view.

photographs accompanying this report. They were made by Carlos H. Elmer who also photographed a few exhibits. Of special interest is the photograph of the high-speed camera used by Dr. Lucien Bull in 1904. Dr. Bull, a member of the Marey Institute of Paris, is still active in the field of high-speed photography and was an honored member of the Congress.

A large portion of the papers were assembled in preprint form at the time of the Congress and now the complete proceedings and discussions have been edited by R. B. Collins to make the volume described below.

PUBLICATIONS

Proceedings and Discussions of the Third International Congress, London, 1956

This volume is to appear in March. 6 × 10 in., xvi + 417 pp., 243 line and halftone illustrations. Published by Butterworth Scientific Publications, 4-5 Bell Yard, Temple Bar, London, WC2. Price $13.00. Distributed in U.S.A. by Academic Press Inc., 111 Fifth Ave., New York 3; in Canada by Butterworth & Co., (Canada) Ltd., 1367 Danforth Ave., Toronto.

Complete description of the volume is available from the publisher and distributors. The contents are 64 items, the last three being reviews of (1) the conference, (2) exhibition and (3) films shown at the Congress. The papers are grouped under these headings: Flashlight Sources; Image-Splitting and Image-Sampling Techniques; Inertialess Shutters; Application to (1) Biology and Medicine and (2) to Machine Analysis; Application to Ballistics and Explosives; Instrument Aids; Photographic Materials; X-Rays; Film Evaluation; Schlieren and Interferometric Techniques; Mechanical Optical Drum Cameras; Medium Repetition Rate Cameras; Application to Aerodynamics; and Application to Hydrodynamics.

The following material which was not included in the final Congress Proceedings *is to be printed in the March/April issue of* The Journal of Photographic Science *published by The Royal Photographic Society of Great Britain.*

1. R. B. Herden, "The Design of a 16mm Missile Camera";
2. M. Sultanoff, "A Model for the Description of the Luminous Events in Steady State Detonation of Pentolite Sticks Obtained From Recent High-Speed Photographic Studies";
3. G. Doughty, "Photographic Instrumentation at Ordnance Proving Grounds";
4. Prof. H. Schardin, "High-Frequency Cinematography in the Shock Tube";
5. Dr. J. S. Courtney-Pratt and D. P. C. Thackeray, "Apparatus for High-Speed Photography";
6. Review of Congress, by Lt.-Col. P. Naslin; and
7. Review of the Published Proceedings, by W. D. Chesterman.

Bibliography

An excellent bibliography compiled by Elsie L. Garvin, Librarian, Research Library, Eastman Kodak Co., Rochester 4, N. Y., was distributed at the Third International Congress, and a limited number of copies are available from the Kodak Research Library. The Bibliography contains the material originally published in the *Journal* in January 1951 and December 1953 plus additional references through December 1955. The references are classified under seven headings: General, Cameras, Lighting, Oscillograph Photography, Schlieren Photography, Technical and Techniques, and X-Ray. The 35-page booklet contains more than 900 references from scientific publications in the United States and Europe.

Transactions of the Second International Congress

This large and handsome book was reviewed in the November 1956 *Journal*, p. 622. Described as "invaluable" and "indispensible" by experts in the field, it contains 68 papers. The index, table of contents, introductions to, and summaries of, the papers, the forewords and the titles of illustrations are all in three languages, English, French and German. The greater number of the papers are in English with the French and German contributions about equally divided. The papers are briefly catalogued in the book review; a six-page listing of the papers presented at the Second Congress is available from Society Headquarters.

The book is edited by Pierre Naslin and Jean Vivie. It was published in 1956 by Dunod, 92 Rue Bonaparte, Paris VI. It contains 483 pages and is profusely illustrated, including 5 color plates. In size it is $8\frac{1}{4} \times 11\frac{1}{2}$ in. and is priced at 6,000 fr. Copies are available from SMPTE headquarters at $17.25.

Publication of the papers presented at the Third Congress by no means detracts from the value of this volume. It is essential equipment for the student, the researcher, the technician and the scientist.

There is some difference in emphasis on subjects discussed at each of the three Congresses. For example, the Second Congress placed more emphasis on the application of high-speed photography to biology and medicine than the Third. A comparison of the Transactions of the Second International Congress with the Third Congress will reveal other significant variations.

SMPTE Reprint Volumes

Since 1949, this Society has made a specialty of publishing high-speed photography papers. In March 1949, the *Journal* had as Part II a 14-paper symposium introduced by John Waddell, the first Chairman of the Society's High-Speed Photography Committee. In November 1949 the entire issue was devoted to high-speed photography.

Beginning in 1950, high-speed photography papers were published in issues

of the *Journal* as soon as practicable after review by the Board of Editors; then these papers were collected and republished as reprint volumes, beginning with Vol. 3 which followed the reprinting of the March and November groups of papers as Vols. 1 and 2.

These first three reprint volumes have long been out of print.

In 1952, Vol. 4 was published, comprising *Journal* papers appearing after those gathered in Vol. 3, 17 papers totaling 162 pp., priced at $2.50.

In 1954, Vol. 5 was issued with 37 papers totaling 349 pp. and priced at $4.50. These papers appeared in the *Journal* from July 1952 through February 1954 and were largely the papers of the First International Symposium.

Plans about the size, contents and price of the Society's next reprint volume, Vol. 6, will be announced in the near future.

HISTORY AND PROGRESS

The birth of high-speed photography is often placed about a century ago when Henry Fox Talbot successfully photographed a section of the London Times while it was being rapidly whirled on a disk.

This information is given in an article by Maynard L. Sandell that appeared in the *Journal*, March 1949, Part II. Although, as Mr. Sandell pointed out, considerable work was done in the field of high-speed photography before 1948, researchers were handicapped by a lack of means of communication and facilities for centralized research. The SMPTE Committee on High-Speed Photography was formed in January 1948 to further and disseminate knowledge in high-speed photography. Four years later, the First International Congress was, according to the Chairman, John H. Waddell, "the culmination of daydreams over a number of years, while we watched the progressive development of high-speed photography."

In the foreword to Volume 5 of the Society's publications on High-Speed Photography, Mr. Waddell said, "Any theory of high-speed photography, to be of import, must succeed in practice. The problems surrounding the dissemination of high-speed photographic knowledge are complex." At the first Congress were gathered "camera designers, scientists, educators, photographers and engineers — the theorist and the hard-headed practician." This meeting was described as representing "the greatest advancement to the science of high-speed photography that had ever occurred."

The Second Congress carried out the promise of the First. The high level of the papers and the significant developments described, many for the first time, manifested the spirit of international cooperation among the attending scientists and engineers. The Third Congress no less than the preceding ones has brought about the "dissemination of knowledge" that is one of the goals set by the Society.

Future International Symposiums

Dusseldorf, Germany, has been chosen as the meeting place for the Fourth International Congress to be held in the Fall of 1958. The Fifth Congress will be sponsored by the SMPTE and will be held in the United States, according to present plans.

No formal plans have been made for the 1960 Congress, although the SMPTE High-Speed Photography Committee which met on October 9 at Los Angeles has already begun to consider the matter of the Fifth International Congress.

A detailed report of the organization of the Third International Congress, and of the difficulties and problems that arose, is being prepared by R. G. Silversides of the British Department of Scientific and Industrial Research. This will be distributed for the assistance of future organizers of such Congresses. Through the offices of the Royal Photographic Society an international committee is being set up to function until the Fourth Congress is held.

American Standard

Dimensions for 32mm Motion-Picture Film, 2R-3000

ASA
Reg. U.S. Pat. Off.
PH22.71-1957
Rev. 222.71-1950

*UDC 778.534.771.531.3

1. Scope

1.1 This standard specifies the cutting and perforating dimensions of 32mm motion-picture negative and positive raw stock film.

1.2 This film is slit to become 16mm motion-picture film with perforations along one edge.

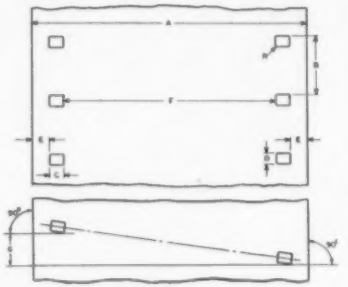
2. Dimensions

2.1 The dimensions shall be as specified in the diagram and table.

2.2 These dimensions apply to the material immediately after cutting and perforating.

2.3 In any group of four consecutive perforations, the maximum difference of pitch (dimension B) shall not exceed 0.001 in. and should be as much smaller as possible.

2.4 The length of any 100 consecutive perforation intervals shall be 30.00 ± 0.03 in., 762.00 ± 0.76 mm.



Dimensions	Inches	Millimeters
A	1.257 ± 0.001	31.93 ± 0.03
B	0.3000 ± 0.0005	7.620 ± 0.013
C	0.0720 ± 0.0004	1.829 ± 0.010
D	0.0500 ± 0.0004	1.270 ± 0.010
E	0.036 ± 0.002	0.91 ± 0.05
F	1.041 ± 0.002	26.44 ± 0.05
G	0.001 max.	0.025 max.
R	0.010 ± 0.001	0.25 ± 0.03

NOTES:

1. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard B48.1-1933 reaffirmed in 1947 providing a conversion factor of 1 inch = 25.4 millimeters.
2. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation pitch (without the decimal point) and the perforation shape (BH, KS, DH or CS) or number of rows of perforations (1R, 2R or 4R), depending on which is the significant factor.

APPENDIX

(This Appendix is not a part of American Standard Dimensions for 32mm Motion-Picture Film, 2R-3000, PH22.71-1957, but is included to facilitate its use.)

The dimensions given in this standard represent the practice of film manufacturers in that the dimensions and tolerances are for film immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but since film is a plastic material, the dimensions of the slit and perforated film never agree exactly with the dimensions of the slitters, punches and dies. Film can shrink or swell due to loss or gain in moisture content or can shrink due to loss of solvent. These

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*Universal Decimal Classification

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ASA\$,M257

Price, 25 Cents

American Standard

Dimensions for 32mm Motion-Picture Film, 4R-3000

ASA
Reg. U.S. Pat. Off.
PH22.72-1957
Rev. 222.72-1950

*UDC 778.534.771.531.3

1. Scope

1.1 This standard specifies the cutting and perforating dimensions of 32mm motion-picture negative and positive raw stock film.

1.2 This film is slit to become 16mm motion-picture film with perforations along both edges.

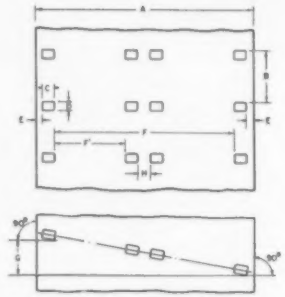
2. Dimensions

2.1 The dimensions shall be as specified in the diagram and table.

2.2 These dimensions apply to the material immediately after cutting and perforating.

2.3 In any group of four consecutive perforations, the maximum difference of pitch (dimension B) shall not exceed 0.001 in. and should be as much smaller as possible.

2.4 The length of any 100 consecutive perforation intervals shall be 30.00 ± 0.03 in., 762.00 ± 0.76 mm.



Dimensions	Inches	Millimeters
A	1.257 ± 0.001	31.93 ± 0.03
B	0.3000 ± 0.0005	7.620 ± 0.013
C	0.0720 ± 0.0004	1.829 ± 0.010
D	0.0500 ± 0.0004	1.270 ± 0.010
E	0.036 ± 0.002	0.91 ± 0.05
F	1.041 ± 0.002	26.44 ± 0.05
F'	0.413 ± 0.001	10.49 ± 0.03
G	0.001 max	0.025 max
H	0.071 ± 0.001	1.80 ± 0.03

NOTES:

1. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard B48.1-1933 reaffirmed in 1947 providing a conversion factor of 1 inch = 25.4 millimeters.
2. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation pitch (without the decimal point) and the perforation shape (BH, KS, DH or CS) or number of rows of perforations (1R, 2R or 4R), depending on which is the significant factor.

APPENDIX

(This Appendix is not a part of American Standard Dimensions for 32mm Motion-Picture Film, 4R-3000, PH22.72-1957, but is included to facilitate its use.)

The dimensions given in this standard represent the practice of film manufacturers in that the dimensions and tolerances are for film immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but since film is a plastic material, the dimensions of the slit and perforated film never agree exactly with the dimensions of the slitters, punches and dies.

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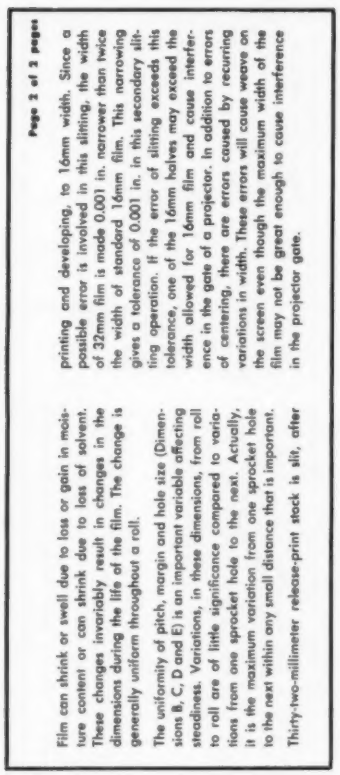
ASA\$,M257

Price, 25 Cents



Page 2 of 2 pages

Film can shrink or swell due to loss or gain in moisture content or can shrink due to loss of solvent. These changes invariably result in changes in the dimensions during the life of the film. The change is generally uniform throughout a roll.

The uniformity of pitch, margin and hole size (Dimensions B, C, D and E) is an important variable affecting steadiness. Variations, in these dimensions, from roll to roll are of little significance compared to variations from one sprocket hole to the next. Actually, it is the maximum variation from one sprocket hole to the next within any small distance that is important. Thirty-two-millimeter release-print stock is slit, after printing and developing, to 16mm width. Since a possible error is involved in this slitting, the width of 32mm film is made 0.001 in. narrower than twice the width of standard 16mm film. This narrowing gives a tolerance of 0.001 in. in this secondary slitting operation. If the error of slitting exceeds this tolerance, one of the 16mm halves may exceed the width allowed for 16mm film and cause interference in the gate of a projector. In addition to errors of centering, there are errors caused by recurring variations in width. These errors will cause weave on the screen even though the maximum width of the film may not be great enough to cause interference in the projector gate.

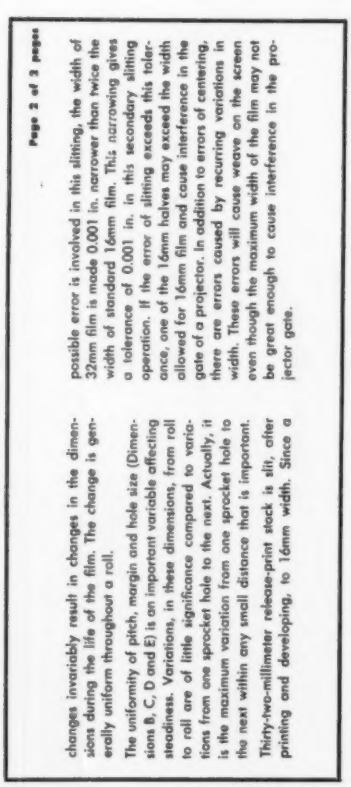
PH22.72-1957

Four American Standards

Published here are American Standards PH22.71-, PH22.72-, PH22.103- and PH22.104-1957 which were approved by the American Standards Association on February 19, 1957.

PH22.71, Dimensions for 32mm Motion-Picture Film, 2R-3000, and PH22.72, Dimensions for 32mm Motion-Picture Film, 4R-3000, are revisions of the 1950 standards Z22.71 and Z22.72. Subsequent to their trial publication in the January 1956 Journal, several modifications of both standards were proposed and approved and are incorporated in these final versions. These include a new title, a minor change in method of diagramming dimension G, addition of two explanatory notes and a slight revision of that section of the appendix concerning steadiness.

PH22.103, 35mm Anamorphic Prints with Magnetic Sound Records, Usage in Projector, and PH22.104, Projector Aperture for 35mm, Anamorphic, 2.55:1 Prints with Squeeze Ratio of 2:1, had their trial publication in the December 1955 Journal and with the exception of new titles are unchanged. — *Henry Kogel, Staff Engineer*



Page 2 of 2 pages

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PH22.71-1957

Proposed SMPTE Recommended Practice

Lens Mount Surface

High-Speed Motion-Picture Cameras

Proposed SMPTE Recommended Practice, Lens Mount Surface, High-Speed Motion-Picture Cameras, is published here for a three-month period of trial and criticism. This proposal was initiated by the High-Speed Photography Committee in December 1955, was approved in October 1956 and has since been approved by the Standards Committee in February 1957.

All comments should be sent to Henry Kogel, Staff Engineer, prior to June 15, 1957. If no adverse comments are received, the proposal will then be sumitted to the Society's Board of Governors for approval as an SMPTE Recommended Practice. — *H.K.*

1. *Scope*

   1.1 This recommendation specifies for high-speed motion-picture cameras the surface for mounting lens adapters.

2. *Lens Mount Surface*

   2.1 High-speed motion-picture cameras shall have a machined plane surface for mounting lens adapters.

   2.2 Data shall be supplied with each camera locating the mechanical and optical distance from this machined surface to the plane of the film.

   2.3 Data shall also be supplied for locating the lens mount radially and for attaching the lens adapter.

American Standard

35mm Anamorphic Prints with Magnetic Sound Records

Usage in Projector

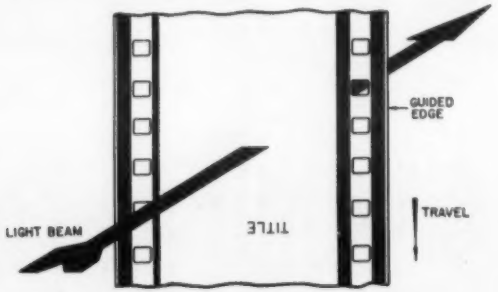
ASA
Reg. U.S. Pat. Off.

PH22.103-1957

*UDC 778.554.45:771.531.551.2

1. Scope

1.1 This standard specifies the location of the photographic emulsion and of the magnetic striping relative to the projector light source and lens, the rate of projection and the relationship between sound and picture of 35mm sound motion-picture film having a 0.073 x 0.078-in. perforation as specified in American Standard PH22.102-1956, Dimensions for 35mm Motion-Picture Film, CS-1870.



Film As Seen From The Light-Source In The Projector

2. Position of the Photographic Emulsion and Magnetic Striping

2.1 The photographic emulsion shall be on the side of the film which faces toward the light-source of the projector.

2.2 The magnetic striping shall be on the side of the film which faces toward the lens of the projector.

3. Rate of Projection

3.1 The rate of projection shall be 24 frames/sec.

4. Relationship Between Sound and Picture

4.1 The apparatus and the film shall be so arranged that when the film is threaded normally, the soundtrack is scanned for reproduction at a point 28 frames behind the center line through the picture being projected. Thus, a given point on the film shall pass the picture aperture after it has passed the magnetic soundhead.

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Price, 25 Cents

American Standard

Projector Aperture

for 35mm, Anamorphic, 2.55:1 Prints with Squeeze Ratio of 2:1

ASA
Reg. U.S. Pat. Off.

PH22.104-1957

*UDC 778.553.2:771.531.551.2

1. Scope

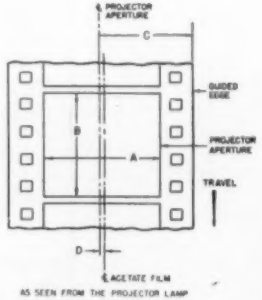
1.1 This standard specifies the dimensions and location of the aperture of projectors used in the projection of 35mm, anamorphic prints having a squeeze ratio of 2:1 and a screen aspect ratio of 2.55:1.

2. Dimensions

2.1 The dimensions of the aperture shall be as specified in the diagram and table.

2.2 Dimensions A and B are specified for an aspect ratio of 2.55:1 and for a projection angle of zero degrees.

2.3 Undersized apertures are required when the projection angle is greater than zero degrees, so that they may be filed to correct for keystone effect (see Appendix).



Dimensions	Inches	Millimeters
A	0.912 max	23.16 max
B	0.715 max	18.16 max
C	0.708 ± 0.002	17.98 ± 0.05
D	0.019	0.48

APPENDIX

(This Appendix is not a part of American Standard Projector Aperture for 35mm, Anamorphic, 2.55:1 Prints with Squeeze Ratio of 2:1, PH22.104-1957, but is included to facilitate its use.)

When the projection angle is greater than 0°, an undersized aperture must be used to make allowance for the keystone effect. This aperture would then be filed out to fit the particular projection angle. The bottom of this undersized aperture is filed out to the maximum width, 0.912 in., to obtain the necessary width at the top of the picture. The sides of the aperture are then filed to square off the picture. This results in dimension A being less than the maximum at all points other than at the bottom of the aperture.

When the projection angle is less than 0°, an undersized aperture also must be used to make allowance for the keystone effect. This aperture would then be filed out to fit the particular projection angle. The top of this undersized aperture is filed out to the maximum width, 0.912 in., to obtain the necessary width at the bottom of the picture. The sides of the aperture are then filed to square off the picture. This results in dimension A being less than the maximum at all points other than at the top of the aperture.

When a curved screen is used the aperture will also have to be undersized with respect to the B dimension to permit the filing of the top and bottom so that these edges of the picture will appear horizontal on the screen.

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Price, 25 Cents

Proposed American Standard:

PH22.111, Picture and Sound Apertures for Continuous Contact Printers for 35mm Release Prints with Photographic Sound Records

A proposed American Standard, PH22.111, Picture and Sound Apertures for Continuous Contact Printers for 35mm Release Prints with Photographic Sound, is published here for a three-month period of trial and comment. This proposal was initiated in October 1954 and was approved by the Laboratory Practice Committee in August 1956 and by the Standards Committee in February 1957.

All comments should be sent to Henry Kogel, Staff Engineer, prior to June 15, 1957. If no adverse comments are received, this proposal will then be submitted to ASA Sectional Committee PH22 for further processing as an American Standard. — *H.K.*

Proposed American Standard Picture and Sound Apertures for Continuous Contact Printers for 35mm Release Prints with Photographic Sound Records	PH22.111

1. Scope

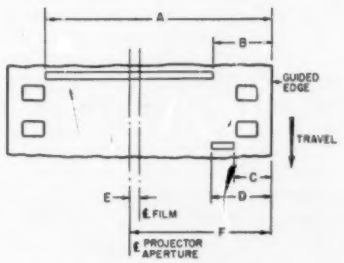
1.1 This standard specifies the location and width dimensions of the picture and the sound apertures of continuous contact printers for making 35mm release prints with photographic sound records.

1.2 This standard is applicable to the printing of motion-picture raw stock film which is cut and perforated in accordance with American Standard PH22.36-1954, Dimensions for 35mm Motion-Picture Positive Raw Stock.

2. Dimensions

2.1 The dimensions shall be as specified in the diagram and Table I.

Note: The centerline information given in Table II is not part of this standard and is provided as a convenient reference. These two dimensions are specified in American Standard PH22.58-1954, Aperture for 35mm Sound Motion-Picture Projectors.



AS SEEN FROM EMULSION SIDE OF PRINT

Dimensions	Inches	Millimeters
A	1.184 ± 0.002	30.07 ± 0.05
B	0.304 ± 0.002	7.72 ± 0.05
C	0.192 ± 0.001	4.88 ± 0.03
D	0.308 ± 0.002	7.82 ± 0.05

Table I

Dimensions	Inches	Millimeters
E	0.049	1.24
F	0.738 ± 0.002	18.75 ± 0.05

Table II

NOT APPROVED

81st Convention Washington, D. C. April 29—May 3

Since the postal announcement was mailed out earlier this month there has been no shifting of sessions and the schedule remains as previously announced. Such stability is quite unusual at this juncture, and speaks well for the pre-Convention planning put in by Joe Aiken, Program Chairman, and Ben Plakun, Paper Committee Chairman.

Papers have continued to come in in good numbers, however, and some of the sessions, like Laboratory Practice, are beginning to burst at the seams with the worthwhile contributions they have to offer. This is undoubtedly going to be a most valuable session. The television sessions also, including as they do the Tuesday morning closed circuit meeting at Walter Reed Army Medical Center and the group of papers on the Ampex Videotape Recorder, will be important. The Ampex papers will be an interesting follow-up on the presentation about this equipment made at the Fall Convention in Hollywood. In the high-speed photography field, members are promised some exciting things in the session on missile photography.

Incidentally, a meeting of members interested in closed-circuit television will be called during the Convention, time and place to be announced. The possible organization of a committee will be discussed at the meeting.

Local Arrangements

The postal announcement included the usual reservation card for accommodation at the Shoreham Hotel, but those who do not happen to have it should send their requests for rooms direct to

Reservation Manager
Shoreham Hotel
2500 Calvert St., N.W.
Washington, D.C.

Single room and bath costs $11.00 per day; double room and bath $15.00; while a suite consisting of living room, bedroom and bath is $25.00.

The Get-Together Luncheon will take place at noon on Monday, April 29, and the main social event, the cocktail party and banquet, on Wednesday evening, May 1.

As before, there will be discount advantages for those who register in advance. Members using the Advance Registration card attached to the postal announcement to buy their weekly registration ($5.00), luncheon ticket ($4.00) and banquet ticket ($15.00) ahead of time will receive a discount of $2.00 on the package, making a total price of $22.00 for the three. There will also be the usual discount for banquet tickets bought in lots of ten or more; this will amount to $2.00 per ticket.

The cost of daily registrations at this convention will be lower than it has been at recent SMPTE conventions. The new prices will be $1.50 for members, and $2.50 for nonmembers.

Ladies program plans and the general arrangements for entertainment and sightseeing are well in hand. There will be opportunities for those who wish to visit all the major places of interest in the capital; and, as described in the February *Journal* and the postal announcement, those wishing to finish up Convention week with a little moree xtended tour of the many places of historical note in adjacent Virginia will find two- or three-day trips available to Williamsburg and the picturesque Jamestown peninsula. In connection with this, there has been considerable interest shown in the new motion-picture theater in Williamsburg, designed by Ben Schlanger, which is being opened to the public at the beginning of April. It is hoped that there may be special arrangements for convention registrants to visit this and to hear something about the theater.

In nearby Jamestown, the festival observing the 300th anniversary of the arrival of the first colonists will be in progress and should be well worth a visit.

The people responsible for coping with all the problems involved in providing a fitting framework for the 81st Convention are:

Local Arrangements Chairman: Keith B. Lewis
Exhibits: Fred W. Gerretson
Public Address and Recording: J. Clinton Greenfield
Hotel Arrangements: Arthur Rescher
Ladies' Committee: Henry M. Fisher
Co-Hostesses: Mrs. Keith Lewis and Mrs. Nathan Golden
Registration: Howland Pike
Auditor: C. E. McGowan
Luncheon: Nathan D. Golden
Hospitality: Frank H. McIntosh
Transportation: Frank G. Kear
Entertainment: Lefferts A. McClelland
Banquet: Dudley Spruill
Projection: Harry DeFuria and Wilson E. Gill
Publicity: James A. Moses and Rae Hargrave
Administrative Assistants: Nick Galminas and Lawrence Wilkinson

Equipment Exhibit

Exhibitors with something to show to the industry will have to hurry if they want to find any space left in the area set aside by the Shoreham for the exhibits. Reservations should be sent without delay to the Exhibit Chairman, Fred Gerretson, c/o E. I. du Pont de Nemours, Photo Products Dept., National Press Bldg., Washington, D.C., who will also be happy to send out details about the Exhibit to anyone who needs them.

Thus far, the following companies have scheduled the showing of equipment:

Animation Equipment Corp.	Neumade Products
Camera Equipment Co.	Precision Laboratories
Andre Debrie Mfg. Corp.	Prestoseal Mfg. Corp.
Electromation, Inc.	RCA Film Recording
Filmline Corp.	S.O.S. Cinema Supply Corp.
Florman & Babb	Sylvania Electric Products
The Harwald Co.	Unicorn Engineering
Houston-Fearless Div.	United Film Corp.
Kling Photo Corp.	Zoomar, Inc.

Tentative Schedule of Committee Meetings

Monday, April 29
2:00 P.M.—Color
2:00 P.M.—82d Convention Arrangements
4:00 P.M.—83d Convention Arrangements
Tuesday, April 30
10:00 A.M.—Film Dimensions
2:00 P.M.—PH22
4:00 P.M.—Association of Cinema Laboratories
Wednesday, May 1
9:30 A.M.—Papers Committee
10:00 A.M.—Sound
2:00 P.M.—High-Speed Photography
2:00 P.M.—Television
2:00 A.M.—Projectionist Information Committee
3:30 P.M.—Closed-Circuit Television*
Thursday, May 2
10:00 A.M.—Laboratory Practice
2:00 P.M.—16 & 8mm
2:00 P.M.—Animation*
Friday, May 3
9:30 A.M.—Board of Editors
10:00 A.M.—Film Projection Practice
10:30 A.M.—Publications Advisory Committee
2:00 P.M.—Screen Brightness

** This meeting is called to discuss the possible formation of a new committee to cover an area outside the scope of existing committees.*

Final schedule will be listed in the Convention Program and meeting notices will be mailed directly to committee members.

RAPID SPRAY PROCESSOR

BY HOUSTON-FEARLESS

The Houston-Fearless 16/35MM Spray Processing Machine, Model S120PN, is the most compact unit yet developed for speed processing and impingement drying at such high rates. 16MM or 35MM positive film processing is accomplished at a rate of up to *150 feet per minute!* Negative 16MM and 35MM film can be turned out at a speed of 100 feet per minute. The dry to dry cycle is *only 6 minutes!*

Five water and vapor-tight compartments, easily accessible, each contain an independent spray system. Flexibility of design permits installation of additional spray chambers. The film passes through a *developer spray chamber; water spray rinse; fix spray; second water rinse; and a spray wash chamber.* Additional operating features include: two dark room loading spindles, load accumulator, automatic locks, a pre-wetting bath, an improved air squeegee, a high speed jet impingement drying cabinet, take off accumulator, and two take up spindles. See this outstanding Houston-Fearless innovation—Spray Processor Model S120PN—at the SMPTE Convention. Or write us for complete, detailed information.

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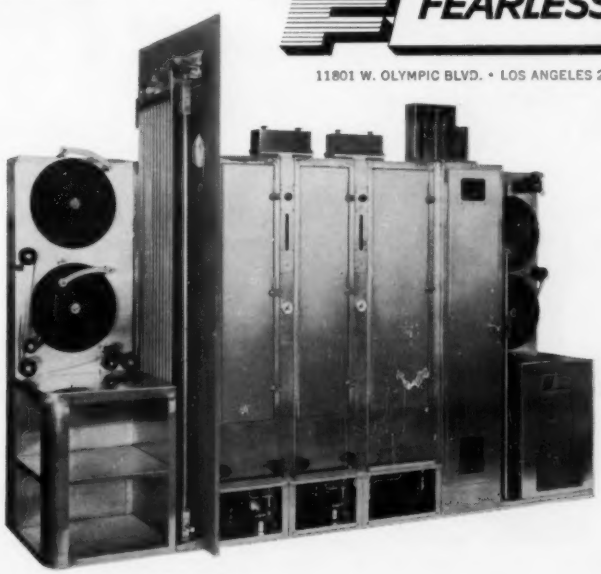

Advance Program

The arrangement of papers shown here is final insofar as is practicable, but between now and Convention time there may be a few last-minute changes.

Since the postal announcement was mailed, the Industry Milestones session scheduled for Monday evening has had to be postponed. The Videotape Recording session is now on Monday evening. Other Television sessions are on Tuesday and Thursday evenings.

Anyone wishing to be sure about the timing of specific papers should inquire a week before the Convention by telephoning either to Joseph E. Aiken, Program Chairman, 116 N. Galveston, Arlington 3, Va. (Washington tel: Ludlow 4-2400, Ext. 355), or to SMPTE headquarters (LOngacre 5-0172).

SUNDAY — APRIL 28
2:00 Registration opens in the West Foyer, Shoreham Hotel

MONDAY — APRIL 29
9:00 Registration
12:00 Get-Together Luncheon

MONDAY AFTERNOON
2:30 STANDARDIZATION

Report on the Activities of the Standards Committee With an Analysis of Product Emphasis Presently Existing in Standardization
GLENN DIMMICK, *Chairman*

Do Standards Inhibit Progress?
M. W. McNAIR, *American Standards Association*

International Standardization Organization
DEANE R. WHITE, *E. I. du Pont de Nemours & Co., Parlin, N.J.*
Plans of the International Standardization Organization with reference to the selection of items suitable for standardization. How I.S.O. actions will affect American equipment manufacturers and film products, and what safeguards exist.

Some Practical Considerations in the Drafting of Standards in the Interest of Reducing Interpretive Confusion
Dr. E. K. CARVER, *Eastman Kodak Co., Rochester, N.Y.*

The Society's Test-Film Standards
BOYCE NEMEC, *Management Consultant, New York*
Uniqueness of content sets one motion picture apart from any other. Yet to reach its audience at all, that same motion picture must be precisely standardized, a rigorous condition not imposed upon any other creative product. One of SMPTE's jobs is to determine "how standard." How this is done through test films is the subject of this paper.

Standardization — A Dynamic Key to Economy
HERBERT RUCKMICK, *U.S. Naval Photo Center, Washington, D.C.*

Department of Defense Photographic Standardization Plans
PHILIP M. COWETT, *Navy Dept., Bureau of Ships, Washington, D.C.*
The 82d Congress enacted Public Law 436, known as the "Defense Cataloging and Standardization Act," requiring that the Armed Forces standardize to the maximum extent practicable. Public Law 1028 of the 84th Congress reaffirmed the intent of the previous Act. Under this direction by Congress, the Department of Defense is exerting every effort in the direction of standardization. Department of Defense plans and methods of accomplishing the desired standardization with examples in the projection equipment field are discussed.

MONDAY EVENING
7:30 VIDEOTAPE RECORDING

Prospective Advances in the Art of Videotape Recording
CHARLES P. GINSBURG, *Ampex Corp., Redwood City, Calif.*

The Video Processing Amplifier of the Ampex Videotape Recorder
RAY M. DOLBY, *Ampex Corp., Redwood City, Calif.*
Due to the stringent requirements of network television, especially with regard to the shape and transient noise content of synchronizing pulses, a special "processing amplifier" has been developed to insure acceptable video waveform at the output of the Videotape Recorder. Similar in concept to a stabilizing amplifier, the new device represents a significant extension of usual stabilizing amplifier techniques. In addition to

The new Camera Pedestal Dolly with instant height adjustment from 25"–57" made easy by accurate counter balancing and by the elimination of friction surfaces. Instant and silent change from tracking to crabbing steering. Weights of up to 250 lbs can be accommodated and up to 500 lbs to special order. An entirely new and unique Pan and Tilt Head, which without the use of Counter Balance Springs gives the outstanding range of 50° of elevation and depression with finger light control. Particularly strong in construction it will support Cameras up to 250 lbs with a large safety margin.

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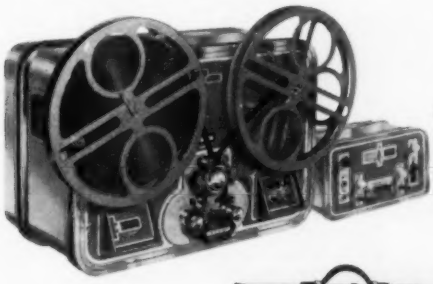

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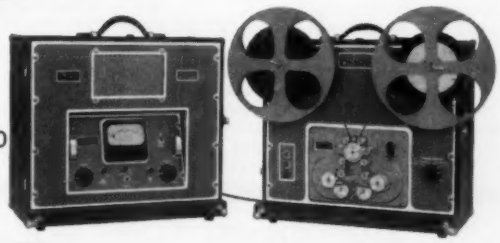

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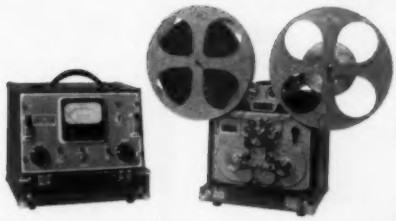

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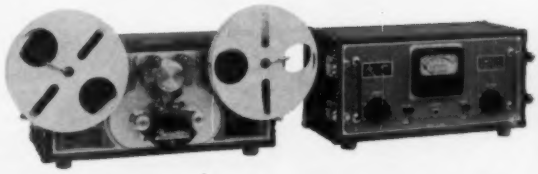

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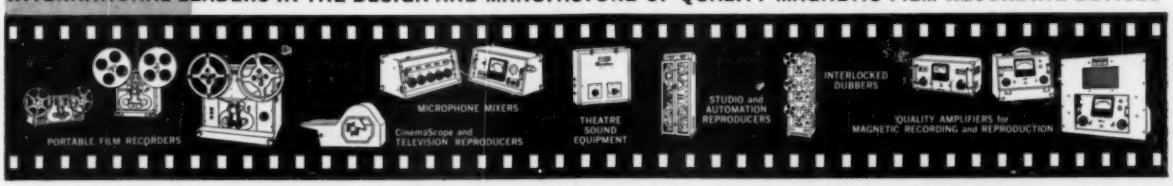

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the usual stabilizing amplifier functions, the Processing Amplifier provides for complete reblanking of the video waveform, with controllable pedestal height and precise gating of the sync pulses, ensuring that noise transients in the black direction will not project beyond reference black level during active portions of the horizontal cycle.

Factors Affecting the Splicing of Videotape
KURT R. MACHEIM, *Ampex Corp., Redwood City, Calif.*

Signal Translation Through the Ampex Videotape Recorder
CHARLES E. ANDERSON, *Ampex Corp., Redwood City, Calif.*

Impact of Videotape Recording on TV Management
ROBERT A. MINER, *Ampex Corp., Redwood City, Calif.*

TUESDAY MORNING — APRIL 30

9:00 Buses leave the Shoreham Hotel for the Walter Reed Army Medical Center

9:30 CLOSED-CIRCUIT COLOR TELEVISION, Armed Forces Institute of Pathology

General Description of the Walter Reed Army Medical Center Television Division
PAUL W. SCHAFER, M.D., *Television Div., Walter Reed Army Medical Center, Washington, D.C.*
This presentation will consist of general briefing concerning the background and mission of the Walter Reed Army Medical Center Television Div. The organization of the facility will be presented from a functional perspective. Administrative policies will be outlined together with a general survey of programming potential.

Color Processing Facilities in the Armed Forces Institute of Pathology
JULIUS HALSMAN, *Medical Illustration Service, Armed Forces Inst. of Pathology, Washington, D.C.*
A description will be given of the color processing facilities of the Photography Div., Medical Illustration Service, Armed Forces Institute of Pathology. The type of equipment used for roll film and sheet film will be illustrated. A brief résumé will be given of processing requirements and quality-control methods that are being used in color processing.

The Technical Facilities Television Division, Walter Reed Army Medical Center
RALPH W. CURTIS, *Walter Reed Army Medical Center, Washington, D.C.*
This presentation will consist of a description of the technical characteristics of the Walter Reed Army Medical Center Television Div. Particular attention will be paid to those unusual equipment items which are involved in television originations from microscopy, surgery and autopsy.

Color TV as a Tool for Medical and Scientific Research
GEORGE A. BAKER, *Television Div., Walter Reed Army Medical Center, Washington, D.C.*
This presentation will concern programming plans and activities of the Walter Reed Army Medical Center Television Div. Particular emphasis will be placed on differences encountered between closed-circuit professional programming and commercial broadcast work.

Demonstrations of the closed-circuit color-television system will show its applications in medical science.

Guided tours of the television installation and the color-film processing laboratory will be conducted following the presentation of the papers.

TUESDAY AFTERNOON
2:00 AUDIO-VISUAL USES OF MOTION PICTURES

The Economic Impact of the Audio-Visual Field

JOHN FLORY, *Eastman Kodak Co., Rochester, N.Y.*

The audio-visual market has grown to the extent that over $1,500,000,000 has been spent for non-theatrical motion pictures and other audio-visual production, release prints, and equipment since World War II. The annual rate is now exceeding $180,000,000. The rapid growth of this little-known facet of the motion-picture industry is of particular significance in view of the startling future growth predicted for the film as an informational medium.

Low-Cost Projection Materials and Techniques

HARVEY R. FRYE, *Indiana University, Bloomington, Ind.*

This article presents a brief discussion of four areas important to those persons interested in the production of low-cost visual materials. Emphasis is placed upon the four areas of mounting, lettering, coloring and photography as the basis upon which most production of visual material depends. A knowledge of these four areas permits the producer to develop any kind of transparency he might desire.

Preparation and Presentation of Low-Cost Projectable Materials

ALLAN FINSTAD, *Ozalid Div., General Aniline & Film Corp., Alexandria, Va.*

This paper introduces the subject with a historical treatment that relates the requirements for low-cost projectable materials to the evolution of the "overhead projector." It describes engineering efforts and design which have given this medium certain advantages of versatility. It further projects engineering goals for overcoming existing limitations. Low-cost projectable types are exemplified with reference to styles of presentation and methods of production.

A Self-Contained 16mm Post-Synchronization Studio

J. P. SEABORNE, *Organization for European Economic Co-operation, Paris, France.*

Because of a multiplicity of languages in Europe, stripe recording has many obvious applications. However, with existing equipment it would be very expensive and complicated to install key centers for high-quality recordings and copy breeding. The paper describes a self-contained recording studio designed to meet these needs but which might have many applications in TV for the post-synchronization of foreign-language versions.

A Foreign-Language Dubbing Conversion

ARTHUR RESCHER and JACK CLINK, *Capital Film Labs., Inc., Washington, D.C.*

A description of the modifications and new equipment necessary to convert a normal studio recording system to the more specialized requirements of the foreign-language dubbing methods. Construction details are supplied. Additionally, a new dubbing studio, now nearing completion, is described.

New Methods of Recording 16mm Magnetic Lip-Sync Sound Using a Magnetic-Optical Sound Projector

LEE T. ASKREN and RAYMOND J. DWYER, *Eastman Kodak Co., Rochester, N.Y.*

Professionally, sound motion pictures traditionally are made by the "double system," affording flexibility in shooting, processing and editing. The methods described open to the amateur and the semiprofessional simple means to accomplish lip-sync 16mm sound using standard available cameras and the Kodak Pageant Magnetic-Optical Sound Projector.

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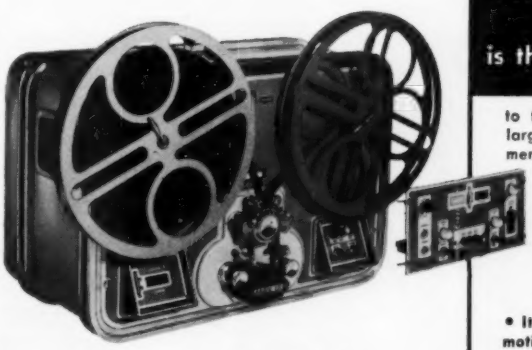

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MAGNASYNC
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Trust your own ears—trust your Sound Man's judgment. Switch to MAGNAPHONIC SOUND.

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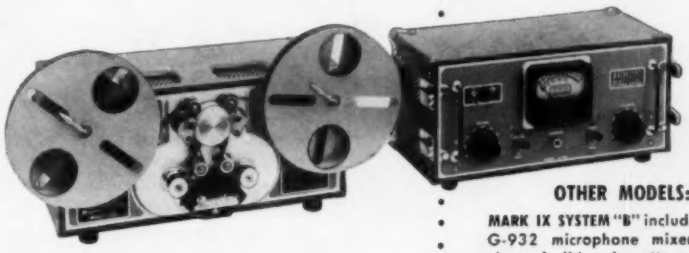
MAGNAPHONIC SOUND SYSTEM, SYSTEM "A"

with built-in record play amplifier and remote control assembly is an engineering achievement with exclusive features found in no other recorder. Has recording, playback, and bias oscillator circuits enclosed in separate plug-in assemblies; easy accessibility to all amplifier components; push-button motor controls; remote control footage counter, record-play & film-direct monitor switches. Available in 16mm, 17½mm & 35mm priced from **$2,145.00**



Model X-400

is a completely synchronous 16mm Magnetic film recording channel, professional in every detail. Can be operated in "console" position, as shown, or stacked as one unit. Features simple camera or projector interlock, instantaneous "film-direct" monitoring, and low power consumption. Ideal for the low budget producer.

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Television — Technological Revolution in Education
HARVEY ZORBAUGH, *New York University, New York*
Television promises the first major technological revolution in education since the invention of movable type. Within the past six years 136 closed circuits have been installed in educational institutions. Few events have engendered the educational interest and controversy than has the intrusion of television into the halls of learning.

Technical and Production Problems in Military TV Recordings
Lt. Col. NORMAN GRAY, *Army Pictorial Service Div., Office of the Chief Signal Officer, Washington, D.C.*
The U.S. Army is producing a series of TV kinescope recordings which will be released to TV stations throughout the United States approximately 15 May 1957. The series is being produced for U.S. Army Recruiting and consists of a 30 minute variety type production. The integrating of stock footage with TV kinescope recordings, editorial, laboratory processing, and production problems will be discussed. a comparison will be drawn between producing the series by standard motion picture techniques versus TV "kinescope" recording. A representative kinescope recording will be shown.

TUESDAY EVENING
7:30 TELEVISION

The Color Television System at the Walter Reed Army Medical Center
ANDREW F. INGLIS, *Radio Corp. of America, Camden, N.J.*

A New Color TV Camera for Medical Applications
NORMAN L. HOBSON, *Radio Corp. of America, Camden, N.J.*

Some Theoretical Aspects of Storing Color Television Information on Black-and-White Film
WILLIAM L. HUGHES, *Engineering Experiment Station, Iowa State College, Ames, Iowa.*
In the past few years at least three systems for recording color television information on black-and-white film have been proposed. It is the purpose of this paper to discuss some of the fundamental problems connected with all three systems irrespective of the relative merits of one to another. Basically, the problem is to replace the color television camera with a piece of film. The film must fulfill the colorimetric requirements of the electronic camera and the film spectral characteristics must be interpreted in that sense. This interpretation of film spectral sensitivity will be discussed. Further, a method of determining the sensitivity function will be presented and examples for typical films will be given. Film processing requirements will be discussed and effects of inherent gamma errors will be considered. Some aspects of the optimum choice of taking primaries will be discussed and film and Wratten filter combinations will be presented for two sets of taking primaries which seem to be most feasible. The relative advantages of each primary system from the registration and noise viewpoints will be presented with emphasis on the reproduced picture in the color television receiver.

Television Line Structure Suppression
F. T. THOMPSON, *Westinghouse Electric Corp., Westinghouse Research Labs., Pittsburgh, Pa.*
Experiments indicate that television viewers select a viewing distance at which the line structure begins to disappear. The advantages and disadvantages of eliminating the line structure are discussed. Several methods of eliminating it are described. The results of an experimental comparison of television pictures with and without structure suppression are given. A photographic comparison is also given.

Advanced Performance and Stability in Color Film Channel Amplifiers
M. H. DIEHL, *General Electric Co., Syracuse, N.Y.*
The use of three-channel automatic gain control, precision gamma circuits, and high-level black clipper, yields long-time stability of the critical parameters affecting color-balance. With large amounts of negative feedback in the monitoring section, drastic reduction in the number of controls, and built-in calibration features, set-up and adjustment can be accomplished very rapidly when necessary.

New Variable-Color Luminous Studio Wall
ROLLO GILLESPIE WILLIAMS, *Color Lighting Dept., Century Lighting, Inc., New York.*
Important developments in studio color techniques that are possible through use of a new high-intensity variable-color luminous wall will be discussed. This wall can be provided with means for instant control of hue, chroma and brightness and for areas up to 3000 sq ft need be only 12 in. deep. A luminous background of this type can immediately produce important color shifts in appearance of foreground objects, enabling color defects to be remedied. Group colors in a foreground arrangement can be harmonized and specific colors emphasized. Dramatic possibilities include mobile color effects, luminous skies, design patterns, scenic effects, silhouettes and color contrasts. Technical information concerning brightness values, color range, current consumption and control methods will also be discussed.

Whether it's for 8, 16, 35 or 70 mm — for cameras, printers, developers, projectors, or allied equipment chances are you require parts similar to those illustrated here. Facilities for the manufacture of precision sprockets, shafts, etc., in experimental or large production quantities are available to you at LaVezzi. We will be pleased to quote on your requirements.
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WEDNESDAY MORNING — MAY 1
9:00 LABORATORY PRACTICE I

Exposure Nonuniformity Produced in Continuous Motion-Picture Printers by Powering Lamps With Alternating Current

JAMES D. CLIFFORD and GEORGE T. KEENE, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*

A theoretical equation relating exposure to printer variables is used in conjunction with experimental data to show the amount of log E ripple produced by 100, 200, 300, 500, 750 and 1,000-w lamps at varied printer conditions. The a-c illuminance modulation effects are found to virtually disappear for all lamps when the film speed through the printer produces an exposure time which is a multiple of the a-c illuminance cycle time. Lamps above 500 w appear to produce a minimum amount of flicker. Exposure nonuniformity is slight at *any* exposure time if 750- or 1,000-w lamps are used.

A "Go - No Go" Gauging Method for Visual Inspection of Release Prints

MAXWELL A. KERR, *Melpar, Inc., Falls Church, Va.*

A method will be explained and demonstrated for using a 16mm projector with a special picture aperture plate as a "Go - No Go" projection gauge for checking several print characteristics while viewing the projected film. This includes checking soundtrack center ring; modulation of variable-area tracks; width of variable-density tracks; variations in width of film stock; blackness and freedom from scratches of soundtrack septum strips; placement and blackness of printed frame around pictures; percentage jump and weave in the projected picture; percent shrinkage of the film stock.

Printing Motion-Picture Films Immersed in a Liquid: Part I — Contact Printing

JOHN G. STOTT, GEORGE E. CUMMINS and HENRI E. BRETON, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*

A printing method is described that gives high-quality motion-picture prints from badly scratched negatives. Both the negative and print film are completely immersed at the printing aperture in a liquid having an index of refraction close to that of gelatin and acetate support. The process nearly completely eliminates the printing effect of scratches and other surface irregularities on the negative, and improves the definition of positive prints by providing a continuous optical medium through which the exposing light passes from the negative to the print film. Demonstration films will be shown.

Printing Motion-Picture Films Immersed in a Liquid: Part II — Optical Printing

JOHN R. TURNER, DUANE E. GRANT and HENRI E. BRETON, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*

A method is described for optical printing of motion-picture film by the use of a projection gate which immerses the film in a liquid of matching refractive index. This permits highly specular printing illumination since scratches and surface irregularities on the film have relatively little optical effect under these conditions. Experimental trials of this method have been carried out on Eastman Color Film at a speed of 90 ft/min. Demonstration films will be shown.

Multiple-Head Reduction Printer

JAMES L. CARLTON and JAMES W. KAYLOR, *Movielab Film Labs., Inc., New York.*

The greatly increased demand for rapid production of 16mm prints from a 35mm original negative has resulted in the development of a multiple-head optical reduction printer capable of simultaneously producing eight 16mm prints with a single pass of the 35mm negative through the projector movement. This printer has been in regular production of black-and-white prints for approximately three years and has now been adapted for additive color printing for the production of 16mm Eastman Color prints.

A Color Timing Calculator for Subtractive Motion-Picture Printers

GEORGE T. KEENE, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*

The advantages of using gray card negative density information to predict color printing packs are discussed. A comparison is made with the use of full-frame integrated density readings as a prediction technique. The design requirements and construction of a slide-rule type calculator are described, and its use in predicting subtractive printer balances from gray card densities is explained. A timing accuracy of ±0.03 log E was attained on the first trial in an Eastman Color Negative-Print system. Equations are included for use of a matrix calculator for this purpose.

A Film on Fader Control for Continuous Printers

GARO W. RAY, *Cine-Video Productions, Stamford, Conn.*

A Means of Preventing Newton's Rings During Contact Printing of Motion-Picture Film

CHARLES E. OSBORNE, *Research Laboratories, Eastman Kodak Co., Rochester, N.Y.*

Certain film structure and processing conditions may result in smooth-surfaced processed negatives and intermediate films which cause Newton's rings when contact printed to smooth-surfaced print films. An application of a fine, evenly dispersed spray of a commercially available printer's non-offset solution to such a film, before printing, effectively prevents these print-

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ing defects. The equipment and method of application are described and the resulting print quality is shown by projection demonstration.

A New Motion-Picture Color Laboratory
JAMES W. KAYLOR, *Movielab Film Labs., New York.*
A modern motion-picture color film laboratory planned for the processing of 16mm and 35mm Eastman Color has been completed by Movielab Film Labs., Inc. The Laboratory occupies a block-long floor of a midtown Manhattan building. This 25,000 sq-ft, completely air-conditioned area houses all of the Color film handling facilities together with the necessary auxiliary equipment.

WEDNESDAY AFTERNOON
2:00 LABORATORY PRACTICE II

A Modern All-Purpose Laboratory
R. W. PAYNE, F. J. QUINN and A. H. VACHON, *National Film Board of Canada, Montreal, Can.*
The National Film Board of Canada has recently occupied its new headquarters in Montreal. The laboratory is planned to handle production and release work in 35mm and 16mm black-and-white for theatrical, nontheatrical and television distribution and 16mm negative-positive and reversal color for the nontheatrical field. The layout, functions and auxiliary services are described. Features of the new plant are the 16mm negative-positive color developing machine, the first of its kind built in Canada and a 16mm black-and-white developing machine designed by the Board.

A 16mm Portable Processor
RALPH D. WHITMORE, JR., *Du Art Film Labs., Inc., New York.*
A major TV network is now using a specially designed 16mm processor for their Newsfilm and Public Affairs section. It is 36 in. long, 36 in. high on a removable wheeled dolly, and 20 in. wide. Yet it will develop high-quality 16mm negative by friction drive at 40 ft/min at 80°F. Power requirements are supplied by two 110-v 15-amp connections. Water is supplied by hot- and cold-water hoses. Included in the machine are: temperature controls for solutions, water and drying air; drying air blower; squeegee compressor; drain pump; circulation agitation; water blender; replenisher system; waxer; torque motor take-up; and film magazines for daylight operation.

A New High-Speed Spray Processor for 16/35 mm Black-and-White, Negative or Positive Film
EDWARD VICTOR LEWIS, *Houston Fearless, Los Angeles, Calif.*

The New ARRI Bottom Drive, an Ideal Construction for Film Developing Machines
ROBERT RICHTER and HERBERT LECHNER, *Arnold & Richter K.G., Munich, West Germany.*
Film-developing machines transport film either by sprocket or friction drive. The advantages and disadvantages of both systems will be discussed. A twelve-minute 16mm color motion-picture film will then be shown of the overall function and detail features of a new ARRI Film Developing Machine which incorporates a completely new ARRI bottom drive. ARRI Machines of this type are already in operation at Pavelle Division of Technicolor in New York, and at Berkey Photo Service in New York, where they are used for processing 16mm and 35mm Kodachrome.

Washing of Color Motion-Picture Film
JOHN R. TURNER, EINAR W. JENSEN and GARETH N. WALL, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
Factors affecting the design of film-washing systems are discussed with particular reference to special considerations involved in the washing of some color films. Washout curves are shown for several black-and-white and color films at various water temperatures. The effects of agitation, and wash-water contaminant level, on washout rate are also shown. The correct design of spray washes requires that careful consideration be given to time, temperature, contaminant level and agitation as related to the specific film type and processing conditions.

A Silver-Recovery Apparatus for Operation at High-Current Densities
NICHOLAS J. CEDRONE, *Hi-Speed Equipment Inc., Waltham, Mass.*
Silver-recovery systems operating at the higher current densities require thorough solution agitation at the cathode surface in order to deposit metallic silver continuously. In the apparatus described, agitation is provided by an external pump. With the solution nozzles located tangential to a cylindrical cathode, high surface velocity is attained and mass flow held to reasonable value. Thus, the problem of excessive mechanical energy input is avoided, while the scrubbing velocity provided permits current densities as high as 10 amp/per sq. ft.

The Preparation or Regeneration of a Silver Bleach Solution by Oxidizing Ferrocyanide With Persulfate
BERNARD A. HUTCHINS and LLOYD E. WEST, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
Ferricyanide, the oxidizing agent of a silver bleach, is prepared by adding potassium persulfate to a solution of a ferrocyanide. The method

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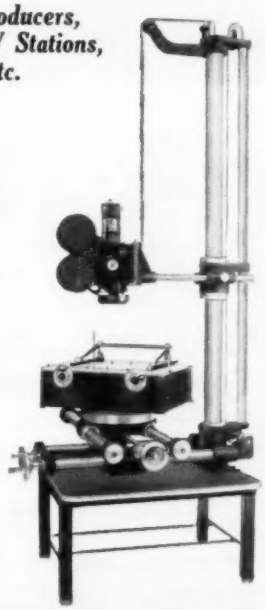

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may be applied for the preparation of a fresh bleach or for the regeneration of a used bleach. The preparation is simple and the ferricyanide may be produced at a substantial saving over purchasing potassium ferricyanide. Methods are included for analyzing the bleach constituents.

Concentrated Developer Replenishers for Eastman Color Film Processing
GEORGE E. CUMMINS, JACK A. COGAN, and WILLIAM R. WELLER, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
By means of concentrated developer replenishers and reduced replenishment rates, substantial savings have been effected in the processing of Eastman Color films through a reduction in the quantity of tank developers overflowed to the sewer. This paper describes the methods used in deriving the concentrated replenisher formulas and the reduced replenishment rates.

A 16mm Process Control Sensitometer
GEO. W. COLBURN, *Geo. W. Colburn Lab., Inc., Chicago, Ill.*
This report describes a sensitometer of the intensity-scale type which exposes a full 16mm frame for each density step. The light source is modulated by a series of apertures giving log E steps of 0.10. The unit is capable of exposing a single strip of 24 frames or a continuous roll of strips 200 ft in length.

Xenon Electronic Flash Sensitometer
CHARLES W. WYCKOFF and HAROLD E. EDGERTON, *Edgerton, Germeshausen & Grier, Inc., Boston, Mass.*
An electronic xenon-flashlamp sensitometer is described for use in black-and-white or color process control. It is an intensity scale instrument with three different exposure durations. The longest exposure, 0.01 sec, is useful for normal picture-taking control. The two other durations of 0.001 and 0.0001 sec allow the laboratory technicians to study film and development characteristics falling in the range of high-speed photography. Color of the light approximates daylight quality without the use of filters and the quantity of light is remarkably constant.

WEDNESDAY EVENING
6:45 Cocktail Party
8:00 BANQUET AND DANCE

THURSDAY MORNING — MAY 2
9:00 THEATER OPERATION — CONCURRENT SESSION

An Improved Heavy Duty 16mm Projector
EDWIN C. FRITTS, *Apparatus and Optical Div., Eastman Kodak Co., Rochester, N.Y.*
The Eastman 16mm Model 25 Projector has been on the market for seven years. It is being revised to give more light and accommodate the reproduction of magnetic sound. The presimplifier is common to this, the Model 25B, and the television adaptation, the Model 275. It handles both the optical and magnetic reproduction. The main amplifier is redesigned to current practice for quality equipment.

Magnetic Playback Head for Heavy Duty 16mm Motion-Picture and Television Projector
EDWIN C. FRITTS, *Apparatus and Optical Div., Eastman Kodak Co., Rochester, N.Y.*
The Eastman 16mm projectors Model 25, and Model 250, are being revised to current standards and practice. The Model 25 becomes Model 25B and the Model 250 is replaced by the Model 275. Both provide for the later addition of a playback from magnetic sound tracks. With additional work, projectors already in use may be altered to receive this magnetic playback mechanism.

Improved 16mm Projector for Research Films
J. S. WATSON, G. H. RAMSEY, and S. A. WEINBERG, *Univ. of Rochester School of Medicine and Dentistry, Strong Memorial Hosp., Rochester, N.Y.*
The flicker-free, slow-motion and single-frame projector described in the November 1954 issue of the SMPTE Journal has been completely redesigned to give more reliable and smoother operation. Cine projection can now be slowed to 3 frames/sec. Single-frame transport has been quieted and speeded up to 0.01 sec with a single shutter blade occultation. Transition between cine and single-frame operation is positive and noiseless.

Balcold Reflector
H. H. SCHROEDER and A. F. TURNER, *Bausch & Lomb Optical Co., Rochester, N.Y.*
An infrared transmitting elliptical reflector for use in motion-picture arc lamps has been developed. The evolution of this optical device, which reduces total radiation by 40% without appreciable light loss, is traced. Engineering aspects of the development of this reflector are discussed. A demonstration emphasizing the properties of the mirror will be given.

Some Comments on Procedures Used to Compare Theater Screens
YORICK G. HURD, *20th Century-Fox Film Corp., New York*
The paper describes ways of comparing the reflecting and light-distribution properties of several theater screen surfaces. Comments are made on instruments (integrating spheres, goniophotometers, spectrophotometers and brightness meters) used in comparing screen surfaces. Lenticular screen design and "gain" formulas are presented with examples of their use in estimating a screen's performance. Data on white, "silver" or aluminum, beaded, pearl, and lenticular screens are included. A screen composed of several screen surfaces will be demonstrated.

Modern Theater Service Procedures
EDWARD STANKO, *RCA Service Co., Inc., Camden, N.J.*
With the development of improved theater sound and projection equipment, the professional theater sound service engineer must keep pace with the technical and engineering developments by constantly improving and, when necessary, revising service procedures. The subject paper deals with the requirements of modern theater service procedures, the methods and equipment used and their overall results.

Equipment Replacement in Army and Air Force Theaters
W. D. SHEPARD, *Army and Air Force Motion Picture Service, St. Louis, Mo.*
The Army and Air Force Motion Picture Service is a self-supporting agency of the Department of Defense. Its mission is the presentation of entertainment motion pictures for morale purposes. The recent innovations in the industry necessitated a major replacement program which largely determines the existing policy. Methods of test, bases of design and the determining effect of military operating conditions on choice of equipment are briefly described.

9:00 INSTRUMENTATION — AND HIGH-SPEED PHOTOGRAPHY — CONCURRENT SESSION

Some Practical Considerations in the Analysis of High-Speed Motion-Picture Data
WILLIAM G. HYZER, *William G. Hyzer & Associates, Janesville, Wis.*
Fidelity of motion-picture images for both visual and quantitative analysis depends upon several factors including optical resolution, image blur, image contrast, image shape characteristics and

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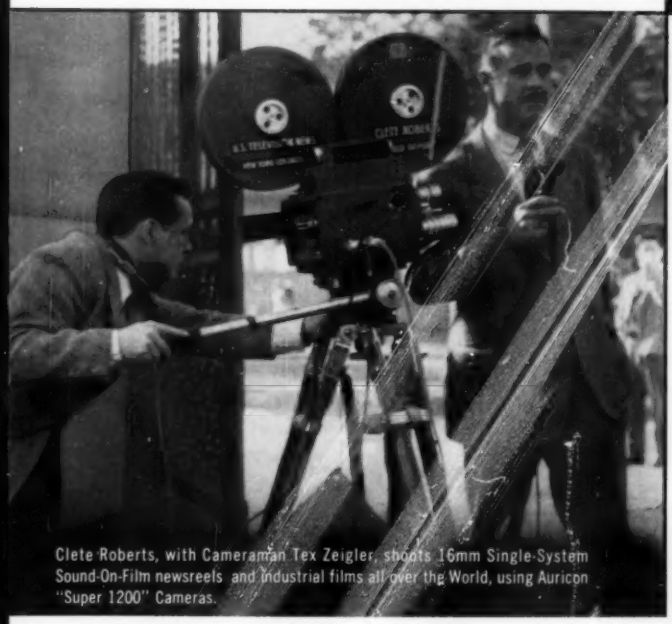

Clete Roberts, with Cameraman Tex Zeigler, shoots 16mm Single-System Sound-On-Film newsreels and industrial films all over the World, using Auricon "Super 1200" Cameras.

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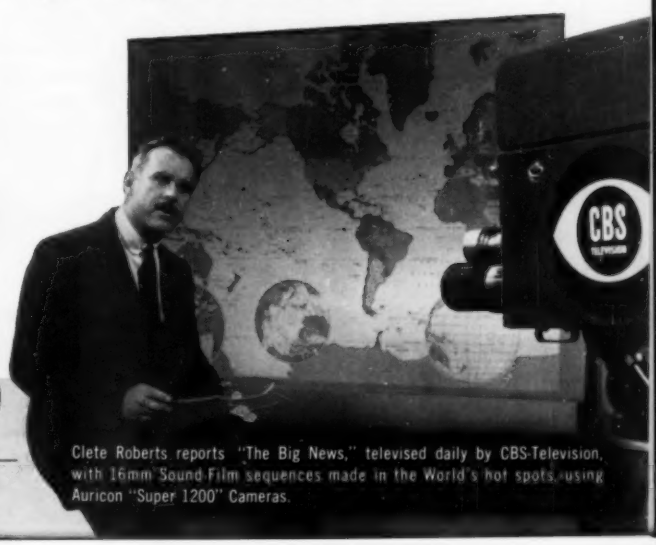

Clete Roberts reports "The Big News," televised daily by CBS-Television, with 16mm Sound-Film sequences made in the World's hot spots, using Auricon "Super 1200" Cameras.

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SOUND-ON-FILM EQUIPMENT SINCE 1931

differential movement of the image from frame to frame. These various factors were considered in a series of practical tests using standard analytical techniques and equipment to determine the contribution of each factor to the overall accuracy of 16mm film evaluation.

Photographic Instrumentation at the Air Force Armament Center
H. C. SCHEPLER, *Air Force Armament Center, Eglin AFB, Fla.*
Precise spatial position of airborne test objects such as rockets, bombs and missiles is recorded photographically on the Air Force Armament Center Test ranges. The instrumentation employed, the use of triangulation in determining spatial position and the accuracies obtained are discussed in this paper.

Lenses Used in Mapping
CLARICE T. NORTON, *Fairchild Camera & Instrument Corp., Syosset, L.I., N.Y.*
There are two orders of so-called distortionless lenses. One type reduces distortion to controllable values, the other, to negligible values. The image and mensuration characteristics of such lenses are discussed and the modern objectives of distortion-free lens design are enumerated. Some of the camera tests and controls which assure high precision mapping are discussed.

Flying Camera Stations
FLOYD A. KINDER, *U.S. Naval Ordnance Test Station, China Lake, Calif.*
This type of instrumentation is based upon the principle of determining aircraft position and attitude by photographing surveyed ground markers with one aerial camera. To obtain attitude, trajectory and documentary data of missiles launched from aircraft at high altitudes, an airborne cinetheodolite based upon this principle has been proposed. Factors affecting the accuracy will be presented.

"Table 210"
GLENN E. MILLER, *Lockheed Missile Systems Div., Van Nuys, Calif.*
This nonclassified 16mm color film with narration explains the making of Documentary Motion Pictures as required under "Table 310" of a Military Contract. It covers the procedures from signing the contract through the film outline as prepared by the Producer, Writer, Project Engineers and Management. The script stresses company policies and sales approach as well as document tests and developments. It shows filming of the picture under all conditions; instrumentation motion-picture techniques and uses, which include on board camera mountings, camera recovery, processing, editing, narrating and dubbing the picture. Uses of the films — both documentary and instrumentation — are also included.

THURSDAY AFTERNOON
2:00 MISSILE PHOTOGRAPHY — A SYMPOSIUM

Atmospheric Optics
H. C. SCHEPLER, *Air Force Armament Center, Eglin AFB, Fla.*
The factors affecting the visibility and photographability of distant objects through the atmosphere are presented. The manner in which each factor deteriorates the visual or photographic image is described. Means are suggested for reducing the effects of these factors to a minimum in the photography of airborne test targets.

Atmospheric Limitations on Missile Photography
S. Q. DUNTLEY, *Scripps Institution of Oceanography, Univ. of California, San Diego, Calif.*
Optical data taken from an aircraft in flight as well as data secured at ground level have enabled the obscuration of high-flying missiles by the atmosphere to be ascertained, and the requirements to be met by telescopic finders and cameras to be specified for several typical weather and lighting conditions.

Optical-Photographic Tracking Instrumentation
A. H. SCHENDEL, *Range Instrumentation Development Div., Integrated Range Mission, White Sands Proving Ground, New Mex.*
Photographic recording of fast-moving objects by means of optical-photographic tracking instruments plays an important role in missile test work. The basic requirements for such instrumentation systems are outlined and a survey is given of the instruments presently in use or under development. Possibilities for future development to meet the increasing demands for highly accurate information on the events going on in space are discussed.

Some Optical Techniques for Determining Rocket Flight Characteristics
WALTER L. HALES, *U.S. Army Ordnance Corps, Redstone Arsenal, Huntsville, Ala.*

A Design and Operational Philosophy for an Ultra-Precision Tracking Mount System for Missile Test Ranges
JOHN A. CLEMENTE, *U.S. Naval Ordnance Test Station, China Lake, Calif.*

Aerodynamic Features With a 16mm On-Board Missile Camera
B. BENJAMIN, *Sandia Corp., Albuquerque, N.M.*

A New Shoulder-Mounted Tracking Camera
A. M. ERICKSON and C. G. GROVER, *Naval Ordnance Laboratory, White Oak, Md.*

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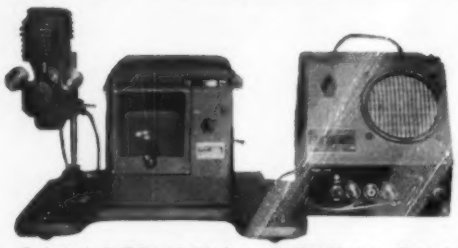

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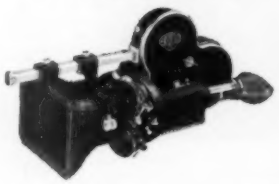

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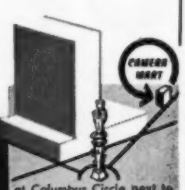

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THURSDAY EVENING

7:30 TELEVISION

Devices for Making Sensitometric Exposures on Embossed Kinescope Recording Film
EDWARD M. CRANE and C. H. EVANS, *Research Laboratories, Eastman Kodak Co., Rochester, N.Y.*
The use, discussed in an article by Evans and Smith in the July, 1956 SMPTE *Journal*, and densitometry, described by Brown, Combs and Smith in the December, 1956 SMPTE *Journal*, of Eastman Embossed Kinescope Recording Film, Type 5209, require flexible but reproducible sensitometric exposure. Whether the exposing condition matches the practical application, or attempts to avoid any electronic contribution to image degradation, certain sensitometer features are generally useful. These features are described, and their application to sensitometers with kinescope and high-intensity flash sources is pictured.

An Operational Method of Checking Colorimetry in Color TV Systems
S. L. BENDELL and H. N. KOZANOWSKI, *Radio Corp. of America, Camden, N.J.*

Black Level — The Lost Ingredient in Television-Picture Fidelity
R. G. NEUHAUSER, *Tube Div., Radio Corp. of America, Lancaster, Pa.*
This paper outlines television-system improvements instituted in recent years which produce and maintain the ability to reproduce proper black level (or dc restoration) in the television receiver. The necessity for proper black-level control in the production of television pictures having good fidelity is discussed, and factors which caused its importance to be minimized in the past are described. Specific equipment and instrumentation advances which have resulted partly from the advent of color television are also described. The entire television system, from the studio to the television receiver, is considered. A suggested waveform standard that can be used to achieve day-to-day and station-to-station uniformity of black-level reproduction is illustrated.

A 16mm Television Projector for Use With a Vidicon Camera
EDWIN C. FRITTS, *Apparatus and Optical Div., Eastman Kodak Co., Rochester, N.Y.*
The Eastman 16mm Television Projector, Model 250, has been in use with the iconoscope for six years. It has also been used with a 2-3-2 mechanism to accommodate the Vidicon. A much simpler modification of the basic Model 25 projector for use with the Vidicon is described in this paper.

Automatic Gain Control in TV Automation
W. H. HOFFMAN, M. H. DIEHL and W. L. SHEPARD, *General Electric Co., Syracuse, N.Y.*

Automatic Program Control for TV Broadcasting
A. C. ANGUS, *General Electric Co., Syracuse, N.Y.*

Transistors
B. R. LESTER, *General Electric Co., Syracuse, N.Y.*

Wide-Screen Television
SEYMOUR ROSIN and MADISON CAWEIN, *Grimson Color, Inc., New York.*
A television system known as "Scanoscope" has been developed in which the aspect ratio has been changed from the conventional 4 × 3 format into an 8 × 3 presentation. Advantages are analogous to those in wide-screen motion pictures. The process is based on the Scanoscope lens described elsewhere. This lens squeezes the image on the camera focal plane, from which it is transmitted with the required megacycle bandwidth. The image is unsqueezed electronically in the monitor. The optical and electronic features are described.

FRIDAY MORNING — MAY 3

9:00 CINEMATOGRAPHY — CONCURRENT SESSION

A New Canadian Government Film Center
GERALD GRAHAM, *National Film Board of Canada, Montreal, Que.*
During the past four years the National Film Board of Canada has undertaken a project to design and construct a new headquarters for all of its operations including production, distribution and technical facilities. This paper describes in general the building and its functions. Problems of overall planning, site selection, layout and construction are covered in some detail.

New Studio Design Features for Commercial Production
JAMES E. LARSEN, *Pres. Academy Films*
The newest soundstage on the West Coast is here described. It incorporates the latest in studio design features. This plant is intended for the production of commercial & educational films as well as TV and theatrical pictures.

Some Considerations of Eastman Color Print Film Dye Stability
PAUL HOROWITZ and WILLIAM R. WELLER, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
The dyes in Eastman Color Print Film are quite satisfactory for stability when the film is processed according to recommended procedures. However, their stability under conditions of high-temperature and high-humidity keeping can be seriously affected by retained hypo and/or abnormal *p*H of the processed emulsion. These conditions can be prevented by following recommended processing procedures, particularly the final wash. A simple method of measuring the emulsion *p*H directly on the processed film, and emulsion *p*H control parameters are described.

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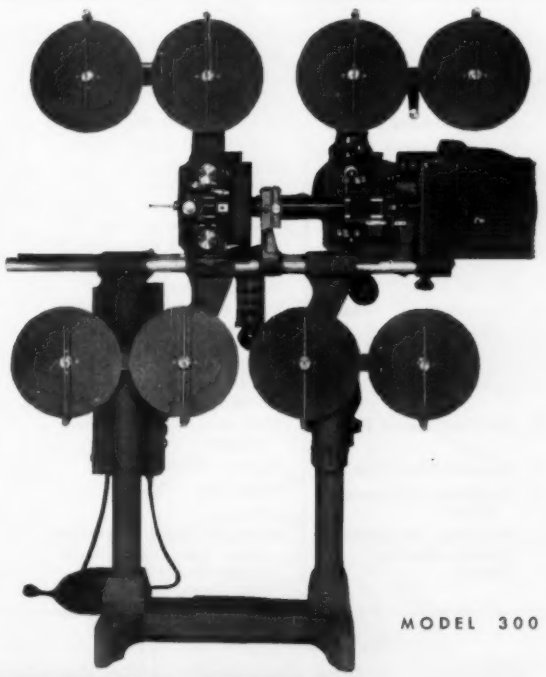
The Peterson Optical Printer is the most versatile and dependable motion picture printer ever designed. The Model 300, shown has a 16mm copying head and a 35mm negative head. This model will reduce from 35mm to 16mm, enlarge from 16mm to 35mm, and print 16mm or 35mm contact. The copying head can be quickly and easily interchanged with a different size (takes less than 5 minutes). Other copying heads available are 35mm, 35mm perforated 32mm, 32mm, and 8mm. The Peterson Optical Printer is also available with a 16mm negative head. Models for reduction printing only and for optical printing only, are also available.

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A New Automatic Iris Control for Motion-Picture Cameras
MERVIN W. LA RUE, JR., *Bell & Howell Co., Chicago, Ill.*
The Bell & Howell Company's new Design 200 EE camera incorporates a self-powered compact automatic iris control. Mechanical power to drive the lens iris originates from a small d-c permanent-magnet motor driven by mercury batteries. A photovoltaic cell deflects a relay meter according to average scene brightness, and opening or closing the motor-battery circuit causes the lens iris to be properly positioned.

Ultra Cold Weather Photography
RICHARD R. CONGER, *Photographer, U.S. Navy, Asst. Photo Officer, Task Force 43 (Operation Deep Freeze)*

An All-Electronic Counter for Film Uses
DON V. KLOEPFEL, *General Film Labs. Corp., Hollywood*
This paper describes an all-electronic footage frame or scene counter having no electromechanical parts, and capable of counting in wide speed ranges. A brief description of beam-switching tubes is given, and construction details noted. Slides of components and slides of functional diagrams accompany the paper.

Anamorphic Lens System
SEYMOUR ROSIN, *Scanoptic, Inc., New York.*
An anamorphic lens known as "Scanoscope" has been developed for use in motion pictures and television. The optical design is described, showing how the aberrations are controlled over a field angle of 80° or more. A unique coupling arrangement allows this lens to be used interchangeably with camera lenses of different focal length in a unit focus arrangement. Application of this system to the Mitchell NC and BNC cameras is described.

9:00 INSTRUMENTATION — AND HIGH-SPEED PHOTOGRAPHY — CONCURRENT SESSION

FRIDAY AFTERNOON
2:00 SOUND RECORDING AND REPRODUCTION

Sound Recording Facilities in Canada's Newest Film Studio
NORMAN F. BOUNSALL, *National Film Board of Canada, Montreal, Que.*
The National Film Board of Canada has just completed a move into a new studio in Montreal. The Sound Division's facilities, which include Re-recording Consoles, a Music Recording Channel, Magnetic Loop Recorders and a new concept in Interlock Motor Control Equipment, are described and illustrated. The engineering methods used to integrate existing recording equipment into a new, enlarged and more flexible system are discussed.

Striped Magnetic Sound in CBS Television News Production
R. C. RHEINECK, *CBS News, New York*
Prestriped magnetic sound on 16mm film as compared to 16mm single-system photographic sound provides the quality advantages of an extended high-frequency response, improved signal-to-noise ratio and lower harmonic distortion. Operating experiences with striped magnetic sound in relation to film striping, camera photography, laboratory processing, editing, film cleaning, printing, projection and library storage are described.

Magnetic Recording Media Considerations for Improving Masters and Dupes
R. J. TINKHAM, *Ampex Corp., Redwood City, Calif.*

Transparent Magnetic Tracks
GEORGE LEWIN, *Army Pictorial Center, Long Island City, N.Y.*
Most of the problems which arise when magnetic and optical tracks are combined on the same film would vanish if the magnetic track could be made transparent, so that both could be superimposed for either simultaneous or independent reproduction. Full-width tracks could be used and head wear would be uniform. The author shows that this goal can be substantially achieved under certain conditions, and will demonstrate several recordings.

Erasing Magnetic Film for Pop-Free Splices
CARL SHIPMAN and CARL HITTLE, *RCA Film Recording Section, Hollywood*
When magnetic soundtracks are edited and then reproduced for motion-picture re-recording or other purposes, the splices in the track frequently cause audible pops to be heard in the reproduced program material. Among the causes of pops is improperly erased magnetic film or tape. Pop elimination from this cause is achieved by use of eraser which does not produce "spokes."

Adapting 16mm Television-Film Projectors for Magnetic Sound Reproduction
W. F. FISHER and R. E. MAINE, *Radio Corp. of America, Camden, N.J.*
The means used to reproduce magnetic sound from film with the RCA line of 16mm television projectors are described. The problems introduced by the necessity of working within the boundaries established by existing designs are discussed; solutions are presented which make the field installation of this feature a simple task.

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1. Level Balance Film	1000-cycle, 4-track	50 ft.	(SL-1)
2. Multifrequency Reel	40 to 12,000 cycles, 4-track	425 ft.*	(MF-1)
3. Loudspeaker Balance Reel	Identical speech and music on four tracks progressively in this order—2,1,3,4	300 ft.*	(LB-1)
4. Stereophonic Reel	Picture with stereo sound and 12,000-cycle control signal on track four	330 ft.*	(ST-1)
5. Flutter Film	3000-cycle, 4-track	50 ft.	(FL-1)
6. Loudspeaker Phasing Film	Signal of uniform level, 400-cycle or 500-cycle frequency-warbled simultaneously on tracks 1, 2, and 3, at a 5-cycle rate (specify crossover frequency desired)	50 ft.	(LP-1)
7. Constant Level Film	8000-cycle, 4-track to check azimuth	50 ft.	(AZ-1)
8. Channel-Four Film	12,000/1000 cycle	50 ft.	(CH-4)
9. Projector Alignment Chart	Picture Only	100 ft.	(PR-1)
10. Projector Alignment Chart—Optical Track	Picture only, standard sprocket holes (made by Motion Picture Research Council)	100 ft.	CSOS

*These lengths approximate.

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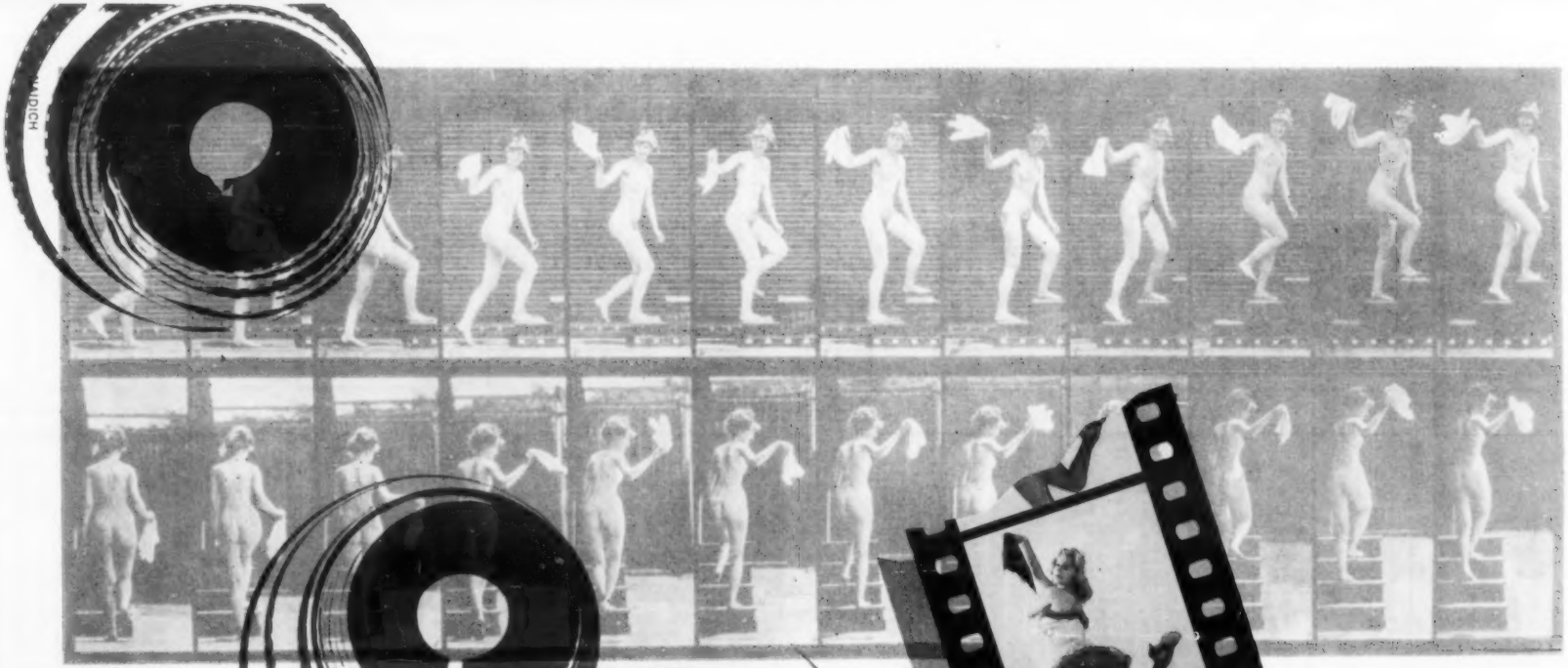

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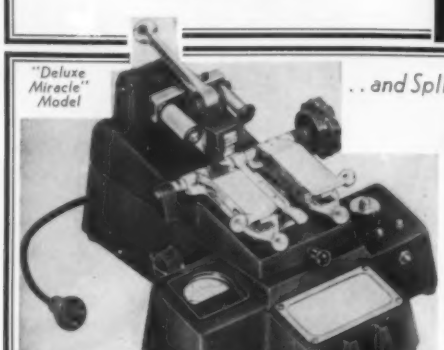

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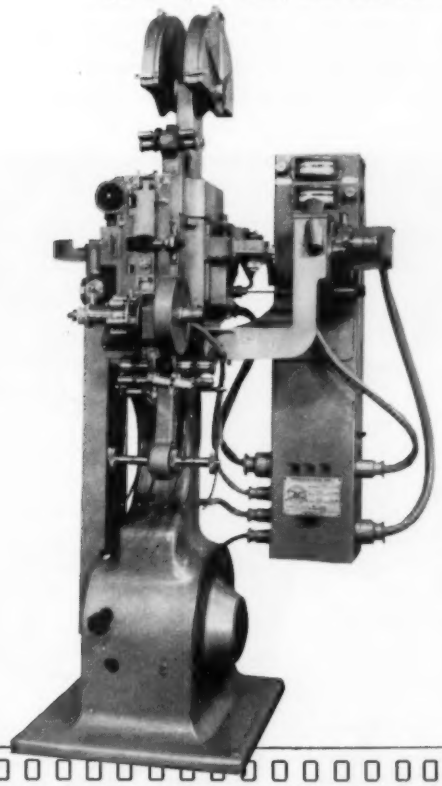

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Education, Industry News

Projectionist Information Committee

Members in the New York area of the Society's Projectionist Information Committee met in New York on February 28 to prepare an agenda for the meeting of the full committee during the Convention in Washington, D.C., April 29–May 3. Ralph H. Heacock, Chairman of the Committee, presided.

Discussion centered around possible methods of getting information to projectionists and exhibitors in the field and the kind of information to be transmitted.

The suggestion was made that projectionists and exhibitors should be encouraged to write to the Committee explaining their problems. Thus the Committee would be in communication with the projectionists and would have a basis on which to define the problems encountered in various areas.

Special emphasis was placed on the publication of articles in the Official Bulletin of the IATSE and elsewhere. The program is being undertaken with the cooperation and assistance of IATSE.

Among the items suggested for discussion by the full Committee was the problem of maintaining two-way communication between the manufacturers and the users of their products. It was agreed that technical information on new processes could be transmitted.

Reports from many areas indicate that the scratched film problem is a serious and recurrent one and it was stressed that this is an area for exploration and education.—*R.H.*

New Society Courses

The Society's educational program for the New York area is well underway. The first session of the course in Sound Recording was held February 6 and the Laboratory Practice course held its first session February 18, both at New York University. Each course has a full attendance.

The tremendous response when the courses were first announced made it necessary to limit the classes to students who could meet certain strict requirements, but even with the limitations, the quotas were rapidly filled and many late applications were rejected. The enthusiasm for the Society's educational program displayed both here and on the West Coast has encouraged the consideration of more extensive plans. There is a distinct possibility that advanced courses will be approved in the near future.

Chairman of the Subcommittee on the Education of Sound Technicians of the New York Section is Edgar Schuller of DeLuxe Laboratories. I.A.T.S.E. is co-sponsor of this course. James Kaylor of Movielab Film Labs, Inc., is Chairman of the Subcommittee on Laboratory Practice.

The best of the 16mm films produced in 1956 will be selected during the American Film Assembly, April 22–26, at the Statler Hotel, New York. The competition is planned to encourage the production of educational films. Included under the four main categories of Education, Industry, Cultural and Medicine are films on such subjects as books and reading, adult education, factory management, mental health, crafts, public health and many others which contribute to community and personal advancement. The Film Council of America has requested persons qualified to act as jurors to submit applications. Further information can be obtained from the Film Council of America, 614 Davis St., Evanston, Ill.

UNESCO has proposed an international system of cataloguing educational and scientific films and film strips. The result of a series of conferences in Great Britain and the United States, the proposed rules are contained in two booklets, "International Rules for the Cataloguing of Educational Scientific and Cultural Films and Filmstrips" and the "Manual for Evaluators of Films and Filmstrips," obtainable from H. M. Stationary Office, P.O. Box 569, London SE1, price 2s. each.

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Safest, most reliable fused stage plug Patented. Floating contacts, smooth connection, jiffy assembly make it the electrician's "pet."

New socket extends globe life. Patented, toggle-operated, spring-loaded socket prevents arcing, grips firm, cuts globe costs.

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"C" clamp with built-in "life-insurance." Only McAlister "C" clamps hook and hug every pipe... the only clamp with the extra piece for "peace of mind"

A report on the use of closed-circuit television in the teaching of two English courses, a Freshman course in Composition and a Sophomore course in English Literature, has been issued by New York University.

The instruction during the school year 1955–1956 was given on an experimental basis with "...the broad purpose of enabling New York University to join with other institutions of higher learning in the attempt to discover as soon as possible the potentialities of closed-circuit television for higher education." The report stated that in the background were "the rising tide of students, the coming shortage of well-educated college teachers, and the problem of how best to use the talents of the ... teachers who will be available."

The report was prepared by Thomas Clark Pollock, with the cooperation of Oscar Cargill, James Loomis and Harvey Zorbaugh. The Studio Director was Robert E. Miller.

The report describes the surveys and extensive opinion polls of students and faculty members at the beginning and close of the experiment and presents an objective and careful evaluation of the results of the surveys. In evaluating the answers to questionnaires it was recognized that some adverse opinions expressed by students may have been based on "normal undergraduate resistance to change...." But "... it is clear that most of the students both began and ended the courses with the opinion that their instruction by television was less effective than instruction by traditional methods."

However, those in charge of the experiments found that "the results during the first year were fully worth the risk and the difficulties encountered. We are much further along now in our knowledge of how to use the medium than we possibly could have been without a year's practical experience; a number of faculty members have now had experience as television teachers; and the available evidence indicates that during 1955–1956 the students were given about the same quality of opportunity for learning by this medium as they would have received in traditional classes."

The British Amateur Television Club has just brought us up to date about its activities.

An Introduction to Amateur Television Transmission by Michael Barlow is a recent publication of the Club. The 31-page booklet is priced at 3/6 in Great Britain and 50 cents in the United States and Canada. The book contains besides an introduction called Fundamentals, parts on the scanning system and video amplifier, time bases and power supplies, simple "live" camera and pulse generator, mixers and modulators, and r-f equipment. The requirements for obtaining a British Amateur Television License are included. The Club's Electrical and Mechanical Standards are set forth after this introduction:

"To enable members to run their equipment with units of other members' equipment, certain standards have been recommended by the Committee. You are not, of course, in any way obliged to comply with the standards, but many members are doing so, and all units available on general loan conform to these standards."

Further information is available from the Club's Hon. Editor, M. Barlow, 10 Baddow Place Ave., Great Baddow, Chelmsford. The Club publishes a quarterly journal, *cq-tv*, which has now reached 31 numbers. An index to Nos. 21 to 30 is available upon request.

One of the most hazardous of postwar jobs can now be performed in safety through the use of closed-circuit television. The gristly task of deactivating "live" bombs and shells left over from World War II has been accomplished at the Army's Seneca Ordnance Depot, Romulus, N.Y., without a single fatality or injury. A high-definition, remote-controlled, closed-circuit TV was installed by General Electric's Communication Equipment Div., Electronics Park, Syracuse, N.Y. The system enabled munitions handlers to watch every detail of the disassembly from behind concrete walls 300 ft removed from the bomb. Whenever a faint wisp of smoke, a sign of excess pressure, is observed, the disassembly machine is idled and water is poured on the bomb.

*CAMERAMAN
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*DIRECTOR
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*PRODUCER
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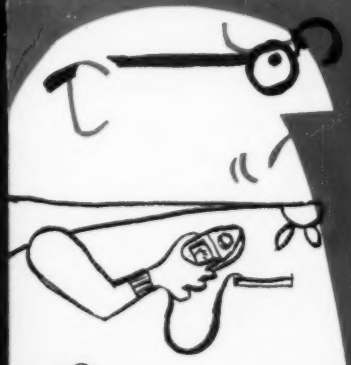

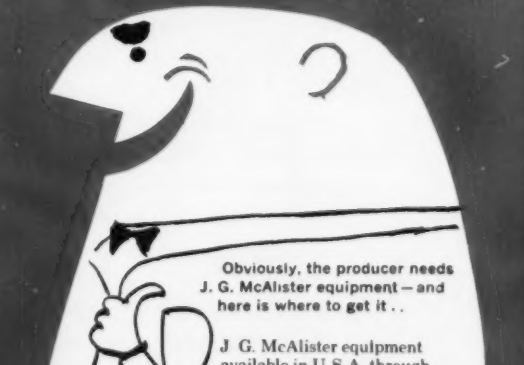

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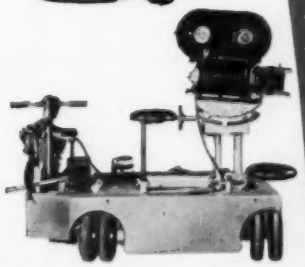
Perma-Lock Mirror guarantees maximum light at all times. Easy access through back door for quick globe change without disturbing light setting.



McAlister's Patented Dual Steering Crab Dolly is a view-finder, a tripod, a crane and a dolly. It goes straight, in curves, in circles and crabs without tracks. Saves time and money. Makes better movies. Awarded an Academy Citation.

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This totally new color printer offers seven advanced features . . . sets new standards for technical precision and operating convenience.

The Bell & Howell Additive Color Printer is the result of intensive research and close collaboration with film laboratory specialists throughout the world. In addition to the features shown here, it incorporates the latest innovations of Bell & Howell's Continuous Film Printers which today print nearly all of the world's commercial film.

1. Controlled Color Density—Available light is separated into the three primary colors: red, green and blue. A system of dichroics is used to produce only pure, narrow color beams. Color intensity is controlled by adjustable vanes which act as light modulators, permitting more or less of each color to pass. The three modified color beams are recombined at the aperture to produce the density and color required for correct printing.

2. Increased Illumination—Equipped with 1,000 watt, high-intensity, prealigned printing lamp. An electrical interlock prevents the lamp from burning unless blower is in operation. Illumination can be reduced for black and white printing.

3. Variable Speeds—60, 90 and 120 feet per minute.

4. Integral Fader—Built into the lamphouse. Adjustable to produce the desired fade length. Fade lengths of 20, 36 and 48 frames are available on 16mm printers, and 16, 32 and 48 frames on 35mm printers. Fade adjustments may be changed during the printing run to produce any of the three lengths.

5. Visual Circuit Inspection—Five pilot lights (with dousers) are mounted on each of the three color banks to permit visual inspection of the electrical circuitry for ease of maintenance. Electronic components are replaced as units, virtually eliminating lost production due to maintenance down time.

6. Automatic Operation—Color and illumination cue controls are actuated by a perforated control tape which is pre-punched on the program perforator. The tape passes through a reader built into the console base of the printer and controls all necessary printing functions with the exception of the fade.

7. Easily Accessible Controls—Mounted on a panel above the printer lamphouse. The *film footage counter* registers up to 10,000 feet of film and can be reset at the start of each film run. The *automatic fader counter* permits the operator to keep count of fades if they are to be varied in length during printing. Both counters are illuminated for easy viewing.

AVAILABLE ACCESSORIES

- **Program perforator for producing control tape**
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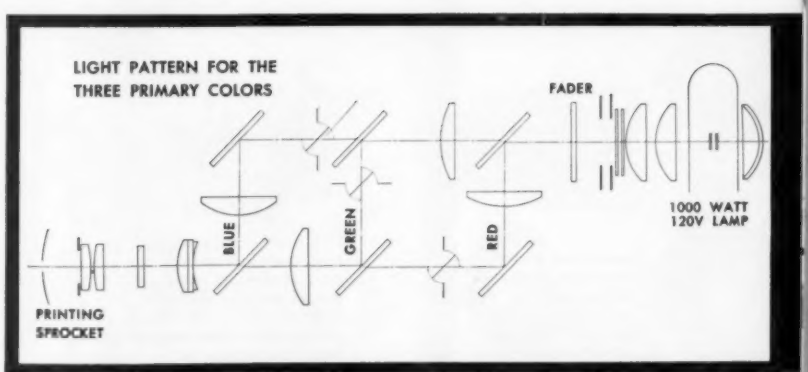

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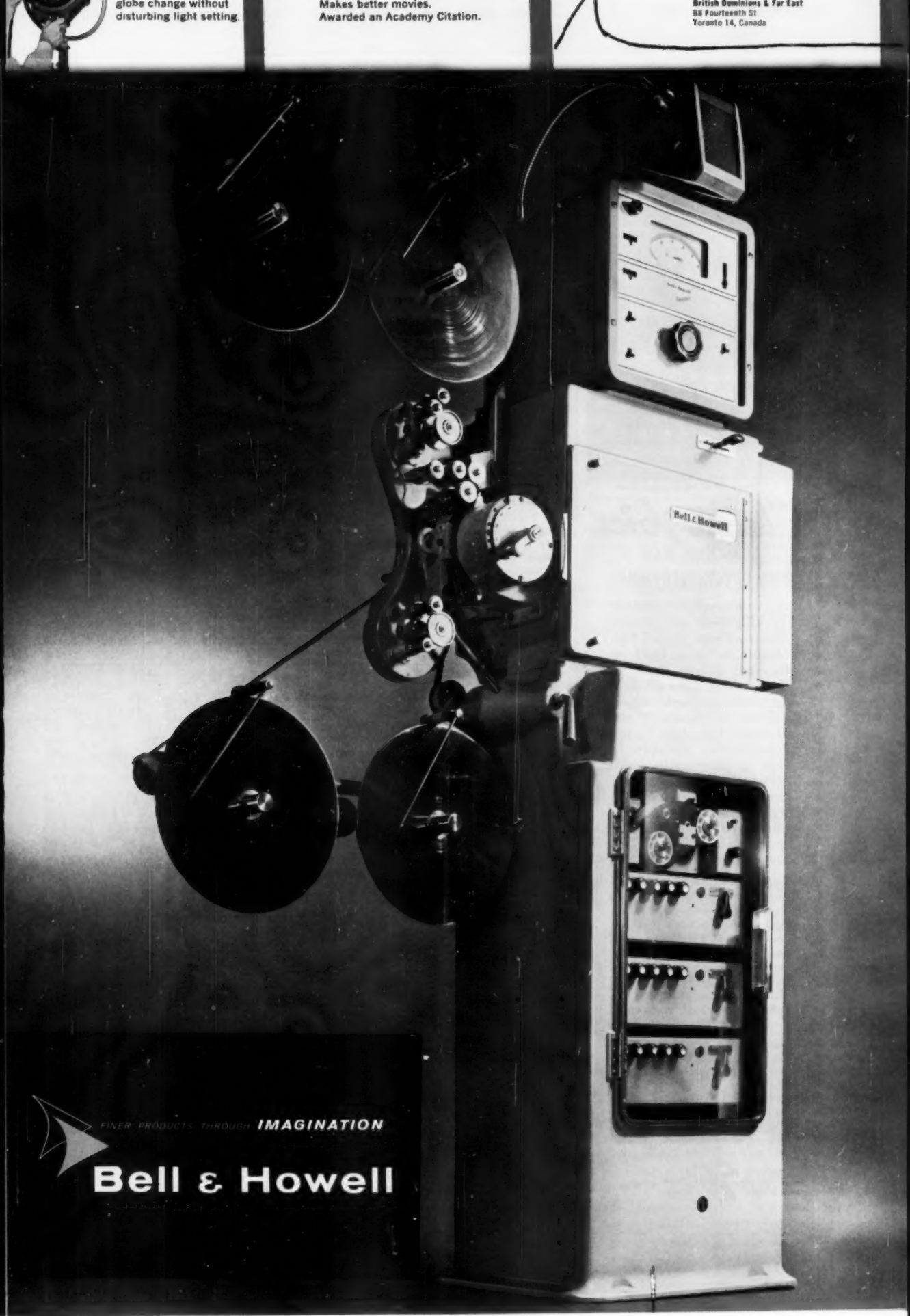

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John K. Hilliard has been appointed Director of Advanced Engineering for Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif. A Fellow of the Society, Dr. Hilliard has achieved international recognition for his achievements in the field of acoustics. He served on the Board of Governors during 1952–53. He has served as a member and as Chairman of the Sound Committee. In his new post he will be engaged in the special products field of electronics and electric acoustics, including instrumentation equipment for high-intensity noise studies associated with jet aircraft and missiles, microphone systems for sound measurement, and powerful speaker-amplifier systems for reproducing these particular sound findings.

John J. Kowalak has joined the Movielab Film Laboratory as Process Engineer for a new color installation. For five years prior to his present appointment, he held the post of Technical Advisor to the Motion Picture Dept. of Ansco's Hollywood Division, where he had been transferred after five years in Ansco's Research and Development Dept. at Binghamton. Among other activities during the time spent with Ansco, he set up a motion-picture laboratory in Mexico City. A member of the Society, he has served as Vice-Chairman on the West Coast Section's Membership Committee.

Carl E. Warner has been appointed Technical Supervisor of the Michael Todd Co., 1700 Broadway, New York 19. Prior to his present appointment he was with the Todd-AO Corp. as staff engineer. Mr. Warner is a member of this Society. He has previously been Director of Sound-Hullinger Productions, Washington, D.C.; Field Engineer, Altec Service Corp.; Motion-Picture Sound Engineer CBS-TV Newsfilm; and Chief Engineer Audiocraft Recording Studios, Miami, Fla.

E. R. Geib, who has been with National Carbon Co., a Division of Union Carbide and Carbon Corp., for nearly 50 years, has been appointed arc carbon sales consultant. Prior to his present appointment he was Manager of arc carbon sales. He is succeeded by J. W. Cosby who has been with the company since 1950 as production engineer and more recently as arc carbon salesman.

Dr. Raymond L. Garman, Executive Vice-President and Technical Director of General Precision Laboratory, Inc., Pleasantville, N.Y., has been elected to the Board of Directors of Simplex Equipment Corp., Bloomfield, N.J., which recently became a GPL subsidiary. The firm was formerly a subsidiary of General Precision Equipment Corp.

50,000 new engineering jobs in the next five years is the estimate of the National Science Foundation. Also estimated are replacement requirements of 12,000 to 15,000 a year. This would mean a required U.S. engineer population of more than 800,000 in 1962, compared with about 560,000 now employed. Also reported in *Electronics* for January 10, 1957, p. 17, is the information that the average pay for newly graduated engineers had increased from $390.00 a month to $450.00 during 1956.

Obituary

Karl Brenkert, Sr., a Fellow of the Society, died April 6, 1956, at his home in Birmingham, Mich. He was born on March 15, 1893, in Detroit. In 1908 he and a brother founded the Brenkert Light Projection Co. which manufactures motion-picture projectors and light sources for use in theaters and television studios. Mr. Brenkert remained as president of the company after its affiliation with Radio Corp. of America in 1945. He retired in 1951. At the time of Mr. Brenkert's retirement, the firm he founded was one of the largest theater equipment companies in the world. Over 60 patents in the industry are owned by the firm.

section reports

The Washington, D.C., Section met for the second time in its history, January 29, in the Jefferson Auditorium, Dept. of Agriculture, with an attendance of 250. The subject of the use of color in motion-pictures and television was explored in a panel discussion by eight specialists. Panel members were: John Wentworth, RCA; George Gordon, Eastman Kodak Co.; Robert Johnson, Byron, Inc.; Neal Keehn, Calvin Co.; Jack Kronmeyer, Ansco Corp.; Gar Misener, Capital Film Labs; Reid Davis and Stanley Parlin, both of NBC.—*James A. Moses,* Secretary-Treasurer, c/o Army Pictorial Service Div., Office of Chief Signal Officer, Dept. of the Army, Washington 25, D.C.

The Dallas-Fort Worth Section met on January 29 at the Southwest Film Center, Dallas, with an attendance of 85 members and guests. Speakers were Ben Frank Worley, Jack Hopper and Irving Gans, all of the Southwest Film Center. Mr. Worley, the architect who designed the combination laboratory and production center, spoke on the subject of "Building Design for Motion-Picture Production and Laboratory." Mr. Hopper presented a paper on "Fast-Acting Additive-Light Source for Color Printing" and Mr. Hopper and Mr. Gans presented a paper on "Selsyn-Powered Continuous Film Processing Machine."—*R. K. Keitz,* Secretary-Treasurer, 7123 Westbrook Lane, Dallas, Tex.

The Hollywood Section met on January 29 at the NBC Color Studio in Burbank, with an attendance of about 275. Joseph J. Bryske, Eastman Kodak Co., spoke on "A Quality-Control Program for Motion-Picture Laboratories," a subject previously presented orally, but not published, by C. L. Graham and R. T. Ryan at the Society's Lake Placid Convention in 1955. Edward Reichard, Consolidated Film Industries, spoke on "A Modern Laboratory for Processing Lenticular Color and Black-and-White Kinescope Films." The talk was illustrated with 57 color slides and covered

the construction and operation of the laboratory from both an engineering and chemical point of view. The meeting was followed by a tour of the new Consolidated Film Industries processing plant.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The Chicago Section met on January 30 at Wilding Picture Productions with an attendance of 325.

The first paper, "Rear-Screen Process Demonstration," was presented by John Constable. First, a demonstration was made of rear-screen projection in a limited space. By use of mirrors, a very effective system was worked out and demonstrated. As a second part of this presentation, a demonstration was made of the effect of proper lighting in achieving realism. Some six scenes were set up to show various lighting effects. The actual scenes were "shot," the film developed and shown later on in the evening. This demonstration was very effective.

The second paper, "Cine-Que," was presented by James Dickert, who demonstrated the prompter and described the system which utilizes an iTV closed-circuit setup which picks up typed information from a standard adding machine tape. The information is typed on this tape by a standard typewriter. The associated mechanical system provides means for passing the tape at a uniform rate through the system.

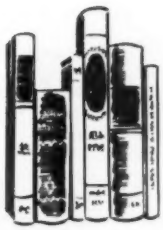
The third paper, "Producer-Laboratory Relations in Print Quality Control," by Harold Kinzle, consisted mainly of demonstrations of various portions of prints in color and black-and-white to show variations in print quality.

The highlight of the evening was a round table discussion paneled by experts from the staff of Wilding Picture Productions. Those who took part in this program and their areas of responsibility were: James Constable, Production Development Dept.; James Dickert, Supervisor, Sound Dept.; Harold Kinzle, Laboratory Superintendent; Duncan Taylor, Manager, Slide Film Div.; and Walter Tinkham, Production Manager. Many points in the field of motion-picture production were brought up for comment and clarification by the panel of experts.

The fourth paper on the program was "Wide-Screen Color Slide Films" by Duncan Taylor. A wide-screen slide film using split-screen effects and a special custom slide projector were demonstrated.

The last part of the program was a screen demonstration of a recently sponsored film. This anamorphic wide-screen projection was presented and discussed by James Constable. The film showed the outstanding opportunities presented by this media for selling new products.—*H. H. Brauer*, Secretary-Treasurer, c/o Bell & Howell Co., 7100 McCormick Rd., Chicago 45.

Membership Certificates (Active and Associate members only). Attractive hand-engrossed certificates, suitable for framing for display in offices or homes, may be obtained by writing to Society headquarters, at 55 West 42d St., New York 36, Price: $2.50.



books reviewed

Elements of Color in Professional Motion Pictures

Prepared by a Special Committee of the SMPTE; *Chairman*, W. R. Holm. Published (1957) by the Society of Motion Picture and Television Engineers, 55 West 42 St., New York 36. 104 pp., 27 in color; 5¾ in. × 8¼ in.; hard-bound. Price $3.50 for single copies (less 20% to SMPTE Members, libraries and booksellers; for 5 through 49 copies, less 25%, plus foreign postage; for 50 copies or more, less 33⅓%, plus foreign postage). Air mail or other special shipping charges to be paid by purchaser. Within New York City add 3% sales tax. Available only for cash with order or by Company Purchase Order.

This book has already been sent to those SMPTE Members who have paid 1957 dues. The prices above pertain to sales to members who wish additional copies.

Elements of Color is a broad and basic treatment prepared by a special subcommittee of the Society's Color Committee. The Foreword by Color Committee Chairman J. P. Weiss and the Introduction by W. R. Holm, Chairman of the special committee, explain generally how a major project such as this is accomplished within the Society's organization — but do not indicate the extent of the work and care given to the editing of the text by Chairman Holm.

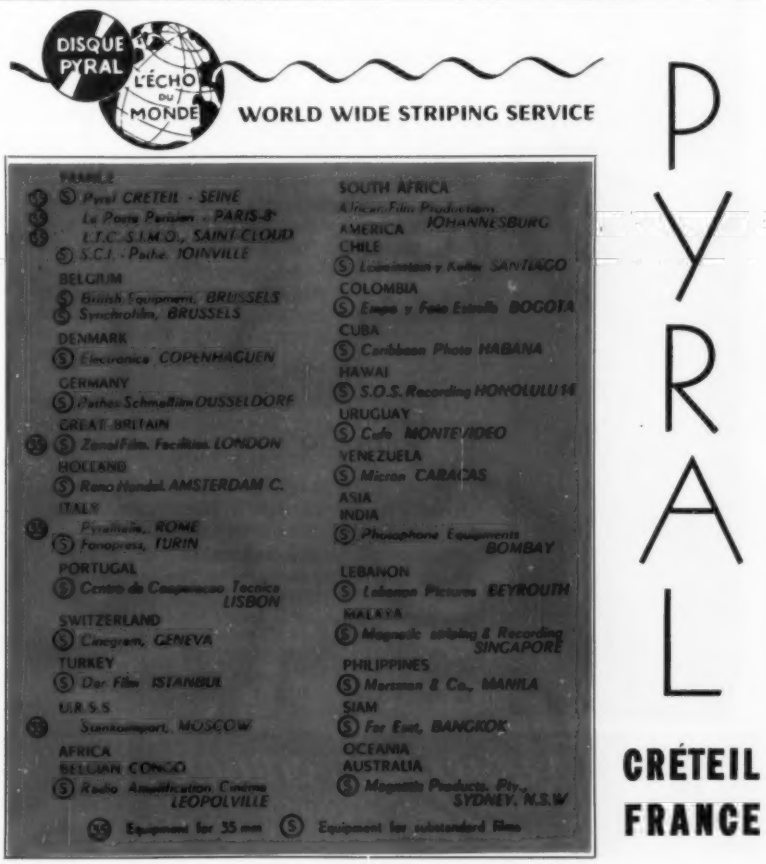
The book reflects not only the direct contributions of the 21 committee members listed in the book but also the indirect contributions made through them by their many associates and the 18 companies and producers the committeemen represent.—*V.A.*

Principles of Color Television

By the Hazeltine Laboratories Staff; Editors, Knox McIlwain and Charles E. Dean. Published (1956) by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. Illus. graphs. 9½ × 6 in. Price $13.00.

Color is a timely subject in both motion pictures and television. With its gradual emergence in broadcasting an exposition of its fundamentals in application to television is appropriate.

The Hazeltine Laboratories, from whose staff the authorship and editorship of this



book are drawn, were prominent in the work of the National Television System Committee, which recommended the present color broadcast standards to the Federal Communications Commission. The volume is addressed particularly to engineers and others who seek a basic understanding of the sources of these standards and how they fit in the current color television art.

The book bases its treatment of the subject on a careful and detailed review of fundamental background material. Five chapters cover various aspects of light, vision and colorimetry; and others cover graphical color reproduction and communications principles. This is applied, step by step, to the evolution of the "compatible" color television signal which was recommended to the FCC.

The treatment then correlates this with the instrumentation that can be set up to produce and use the signal. It covers cameras and other pickup systems and color television receivers. A key element in the latter is the color picture tube. Several forms of this, with necessary auxiliary electrical circuits, receive attention.

A welcome chapter is that on test and measuring methods. These techniques are essential to maintain any working installation of color television. Further chapters give detailed standards, formulas and a glossary of terms.

In contrast with these subjects, possibly transmission (over broadcast propagation, intramural and common carrier paths) is treated a bit sketchily. The assumption is made that comparatively few problems in transmission are added by the insertion of color, and these are given only incidental paragraphs.

The book will be a useful reference in the library of the television engineer. Others who deal with visual and electronic arts will also find in it material of value.—*Pierre Mertz*, Bell Telephone Laboratories, 463 West St., New York 14.

Analysis of Electric Circuits

By William H. Middendorf. Published (1956) by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. i–xiv + 298 pp. + 8 pp. index. 318 illus. 6 × 9¼ in. Price $6.00.

Generally, books on circuit analysis fall into one of two categories: They either apply a revolutionary, new approach to what is by now often — and fallaciously — regarded as a subject far removed from the frontiers of science; or they are a rehash of other works on the subject.

Although the present work quite definitely does not fall into the former category, the author's approach is fresh enough to save the text from being classified in the latter.

In barely three hundred pages Professor Middendorf manages to present steady state analysis both clearly and exhaustively, a feat which points toward the major virtue of the book: organization. The work begins with succinct statements of Coulomb's Law, Faraday's Law, Ohm's Law, Kirchhoff's First and Second Laws, and the instantaneous power equation. This section is followed by definitions of terms (and ASA standards are used throughout!) and a brief chapter on complex algebra. That much background having been provided, conventional steady state circuit analysis is presented in rather conventional form, with the conventional chapter on locus diagrams (often called "graphical analysis") followed by a conventional chapter on resonance, and rounded off with a perhaps less conventional chapter on Magnetic Coupling.

Part II of the text, called "Extension of Basic Circuit Analysis" contains a chapter on Nonsinusoidal Waves and one on Network Theorems. In the latter chapter, the author discusses mesh star transformations, equivalent sources, superposition, reciprocity, Thevenin's and Norton's theorems, maximum power transfer theorem and four terminal network notation. The chapter should be required reading for all those who have up till now quietly (who would dare voice such a question?) wondered, of what earthly use the reciprocity theorem is.

Finally, the third part of the book consists of a chapter on polyphase circuits (for power engineers) and a chapter on high Q circuits (for communications engineers). It is not quite clear why the book does not, instead, contain a section on transient analysis (for *all* electrical engineers). In fact, it is so difficult to conceive of an electrical engineer who has no need for transient analysis, that the omission of this subject from the text necessarily limits the book's usefulness as a course text or as a reference.—*G. F. Paskusz*, Dept. of Engineering, University of California, Los Angeles.

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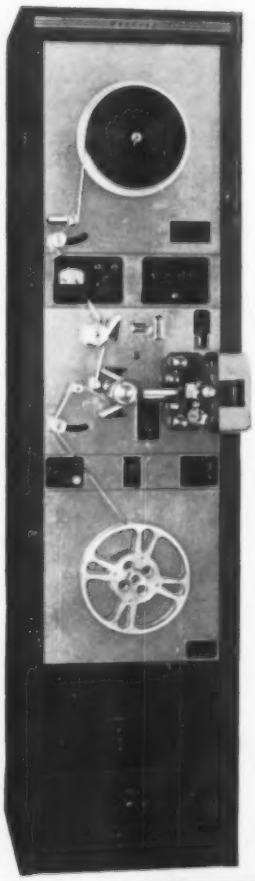

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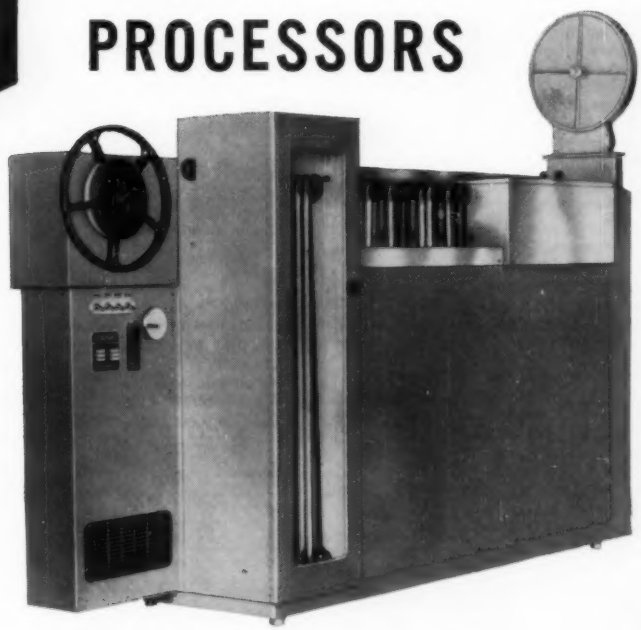

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current literature

The Editors present for convenient reference a list of articles dealing with subjects cognate to motion-picture engineering published in a number of selected journals. Photostatic or microfilm copies of articles in magazines that are available may be obtained from The Library of Congress, Washington, D.C., or from the New York Public Library, New York, N.Y., at prevailing rates.

American Cinematographer vol. 37, Nov. 1956

Electronic Splicing (p. 663) *J. Forbes*

Naturama—Republic's New Wide-Screen Process (p. 668)

Telescopic Tracker (p. 671)

Gun Camera in Unique Role (p. 672)

Simple Animation Techniques (p. 674) *P. Gibbons*

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Multiple Camera Control in TV Filming (p. 722) *A. Stensvold*

Film Production at the State University of Iowa (p. 726) *S. E. Nelson and J. Mercer*

It's Done With Mirrors (p. 728) *R. C. Horn*

Jack Cardiff's VistaVision Venture (p. 732) *D. Hill*

Shooting Night Scenes in Daylight (p. 735) *C. G. Clarke*

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Dolly Shots in Miniature . . . (p. 24) *A. Boyars*

Apparatus for Time-Lapse Photography (p. 28) *A. Rowan*

Techniques of Hollywood Cinematographers (p. 34) *J. Henry*

Corrective Make-up Aid to Cinematography (p. 36) *L. Allen*

New Bolex Underwater Case (p. 38) *A. D. Roe*

British Journal of Photography vol. 104, Jan. 1957

Todd-AO (p. 42) *S. W. Bowler*

British Kinematography vol. 29, Oct. 1956

Twenty-five Years of Progress (p. 115) *R. H. Cricks*

Twenty-five Years On (p. 120) *B. Honri*

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Lighting for Film Production (p. 125) *R. L. Hoult*

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Dynaphostics: The Application of Electric Lighting to Cinematography (p. 144) *F. S. Hawkins*

Synchronous Magnetic Recording on 16mm. Film (p. 154) *H. A. Thomson*

Photokina, 1956 (p. 167) *R. H. Cricks*

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Practical Acoustics in Cinema Auditoria (p. 186) *J. M. Carson*

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Faster Pulldown Geneva Movements (p. 13) *J. M. Ruiz*

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Free-Field Technique for Secondary Standard Calibration of Microphones (p. 110) *A. L. Seligson*

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Die Theorie des Farbfilms unter neuen Gesichtspunkten (p. 383)

Technische und Künstlerische Probleme des Farbfilms (p. 386)

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Motion Picture Herald (Better Theatres Section) vol. 206, Feb. 1957

Small Perforations for All Prints (p. 25) *G. Gagliardi*

Philips Technical Review vol. 18, Dec. 7, 1956

A Flying-Spot Scanner for Televising 35mm Film (p. 193) *F. H. J. van der Poel*

RCA Review vol. 17, Dec. 1956

Reduction of Co-Channel Television Interference by Precise Frequency Control of Television Picture Carriers (p. 443) *W. L. Behrend*

A Miniature Vidicon of High Sensitivity (p. 460) *A. D. Cope*

Transistorized Television Cameras Using the Miniature Vidicon (p. 469) *L. E. Flory, G. W. Gray, J. M. Morgan and W. S. Pike*

Viewing Storage Tubes for Large Displays (p. 503) *H. O. Hook, M. Knoll, and R. P. Stone*

Test Signal for Measuring "On-the-Air" Color-Television System Performance (p. 553) *R. C. Kennedy*

A Video Automatic-Gain-Control Amplifier (p. 558) *J. O. Schroeder*

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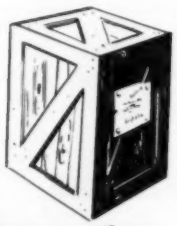

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An Adaptable Automatic Exposure Control

By MARK MacINTOSH

[This paper was presented on October 10, 1956, at the Society's Convention at Los Angeles, by the author, Vice-President of the Traid Corp., 17136 Ventura Blvd., Encino, Calif.]

The AUTEX* is a widely adaptable automatic exposure control that can adjust the aperture setting of practically any lens on any still, motion-picture or TV camera automatically, instantaneously and continuously to maintain the best film exposure during wide ranges of light level changes.

The AUTEX is particularly useful on any camera that is remotely placed so that a human operator cannot adjust the lens aperture for changing light conditions. Another very important application for such an automatic exposure control is on cameras that are to be "panned." When either a hand-held or tripod-mounted camera is being "panned," the photographer can follow a subject from deep shade to bright light, or vice versa, without stopping to change the lens aperture. As the camera follows the subject, the lens aperture is automatically and continuously adjusted to the changing light conditions with an exceptionally fast response rate of approximately five *f*-stops in one second.

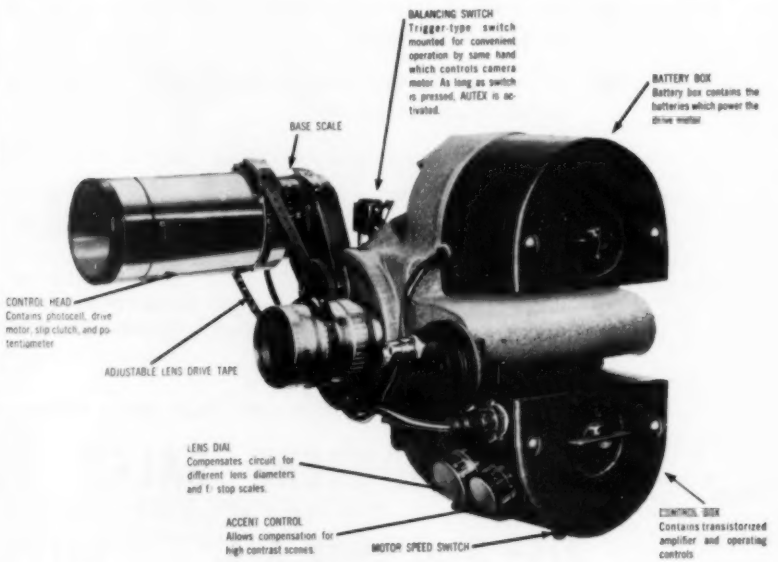
The unusual sensitivity of this exposure control system allows full advantage to be taken of high-speed films and lenses using available light techniques.

This automatic exposure control is proving exceptionally useful to newsreel and documentary photographers, commercial motion-picture photographers, press photographers, military photographic instrumentation engineers and in industrial and research applications where motion-picture cameras and remote closed-circuit TV cameras are stationed in dangerous or inaccessible places.

Because of the ease with which it can be attached, this automatic control system may be readily applied to other situations requiring the positioning of a device in response to changes in light level, for example, artificial fill-in lighting might be controlled according to the prevailing natural light.

Here is how the AUTEX works: The cylindrical control head is installed on the face of the camera, adjacent to the lens and parallel to the optical axis (see illustration). The control head contains a photocell, a potentiometer, a slip clutch and a small, powerful drive motor. When the camera is pointed at a scene, the photocell in the control head accepts the same light as the lens. A change in photocell voltage, caused by a change in light level, trips a small relay. A unique transistor-relay circuit, developed especially for this equipment, controls the drive motor. The motor, powered either by a small battery supply or by an external source of direct current, rotates the control head so that the adjustable lens drive tape moves the lens iris ring in the proper direction to correct for the change in light level. A balancing potentiometer in the head "feeds back" the

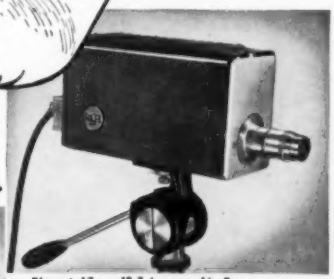
* Trademark.


BALANCING SWITCH
Trigger-type switch mounted for convenient operation by same hand which controls camera motor. As long as switch is pressed, AUTEX is activated.
BATTERY BOX
Battery box contains the batteries which power the drive motor
BASE SCALE
CONTROL HEAD
Contains photocell, drive motor, slip clutch, and potentiometer
ADJUSTABLE LENS DRIVE TAPE
LENS DIAL
Compensates circuit for different lens diameters and f/ stop scales.
ACCENT CONTROL
Allows compensation for high contrast scenes.
MOTOR SPEED SWITCH
CONTROL BOX
Contains transistorized amplifier and operating controls

Elgeet LENSES AT WORK

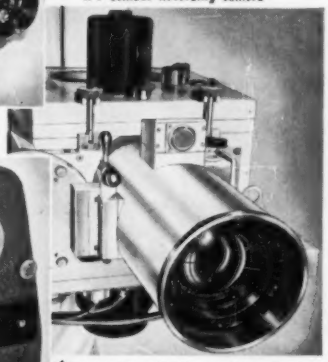
As the "eye" of the camera, the lens is one of the most important elements of a good camera . . . and is often a vital key to superior photography. The lenses of today are no longer simple one or two element lenses. Advanced cameras require fast, high quality lenses . . . lenses that will stop high speed action, produce pictures of superb detail and definition. To meet these requirements Elgeet combines advanced optical engineering, precision craftsmanship and modern electronic equipment . . . to produce lenses of optimum quality to serve your photographic needs. Elgeet's record of results can be attested to faithfully by leading industrial companies and governmental agencies.

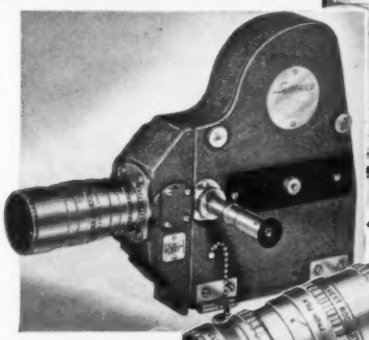
Elgeet 2" f1.5 lens on RCA Vidicon (TV Eye) Camera ▶



◀ Elgeet 17mm f2.7 lens on Air Force N-9 Combat Recording Camera

Elgeet 10" f3.5 lens on CZR-1 Missile Tracking Camera ▶





◀ Elgeet 13mm f1.5 lens on Fairchild High Speed Camera

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◀ **Elgeet Aspheric Golden Navitar** 12mm f/1.2 wide angle lens for 16mm movie cameras . . . the WORLD'S FASTEST WIDE ANGLE LENS . . . enables YOU to take movies in plants, factories, offices, etc. with "available light".

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Elgeet OPTICAL COMPANY, INC. 844 SMITH STREET · ROCHESTER, N. Y.

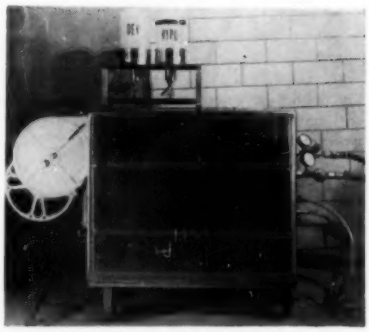
lens setting to the circuit so that the relay opens and the motor stops when the lens is set properly for the new light condition.

The circuit is electrically matched to various lenses by setting the lens dial. Settings for different film speeds and different shutter exposure times are easily made on the base scale on the control head. The ACCENT CONTROL* allows the photographer to adjust the automatic control so that the lens aperture will open to a position either more or less than the setting called for by the average scene brightness. This permits instant compensation during filming of high contrast scenes where the object of interest is brighter or darker than the average scene brightness. With the automatic control properly adjusted for a specific lens and the ACCENT CONTROL set at zero, the lens *f*-stops will "track" accurately and consistently with light meter readings made from the camera position.

The complete kit consists of: (1) the control head and lens drive tape; (2) an adapter to attach the control head to a specific camera; (3) small box (or two small boxes as shown in photograph) containing all circuitry, batteries, calibration dials, etc., necessary to operate the equipment.

The AUTEX was designed and is manufactured by Flight Research, Inc., Richmond, Va., and is distributed west of the Mississippi River by Traid Corp.

* Trademark



A portable 16mm film processing machine designed and fabricated by R. D. Whitmore, Jr., under the direction of CBS Engineering and CBS News Engineers, was used commercially for the first time during the Presidential Inaugural weekend. Designed for fast processing of spot news film reports, high-quality negative is reported to be developed at 40 ft/min and at 80 F. Speed is adjustable from 0 to 40 ft/min through a friction drive and the solution temperatures are adjustable from 80 to 100 F. When removed from its wheeled dolly the machine is 36 in. long, 29 in. high and 20 in. wide.

Its power requirements are supplied through two 110-v, 15-amp cables that plug into standard house outlets. Water is supplied through hot and cold water hoses which may be connected in a house to laundry faucets. It also utilizes a drain pump and a drain hose. It is daylight operated and magazine loaded. Replenishment is supplied through flowmeters from bottles supported by a removable assembly. All controls and switches are recessed into the top of the machine which has been designed for simplicity in servicing and operation. Concentrated developer and hypo are available and can be mixed in the machine during start-up. A combination overall or edge waxer has been included with the removable take-up assembly to make it a complete film processor that does not require additional auxiliary compressors, blowers, pumps, heaters or controls Further information about the machine, which is expected to be produced at about $7500, is available from Ralph D. Whitmore, Jr., 245 West 55th St., New York 19.

The André Debrie Mfg. Co has been acquired by the Belock Instrument Corp. of College Point, N.Y. The André Debrie Mfg. Co. has been distributor of commercial motion-picture and photographic equipment of Etablissements André Debrie, Paris. Operating as a wholly owned subsidiary of Belock and under a new 10-year franchise, the André Debrie Mfg. Co. will have the exclusive rights to manufacture and to sell all products of the French firm, throughout the United States, Canada, Cuba, Formosa and the Philippines. Gilbert Ruellan, son-in-law of André Debrie, founder of the French company, is a director of the new organization. Edgar M. Burlin continues as President of André Debrie Mfg. Co.

Harry D. Belock, President of the Belock Instrument Co., is a member of this Society, and has been active in the technical development of motion-picture equipment.

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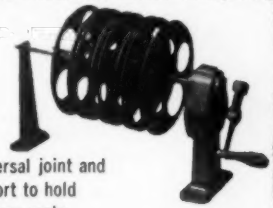
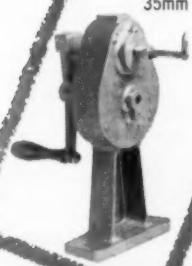


REF-1
friction control rewind w/1 reel shaft 35mm.

RETWC-1
rewind w/16 - 35mm combination tightwind

RE-1
rewind w/1 reel 35mm shaft



SB-1
swivel base attachment for rewind

SP-16 (16mm) spacer
SP-35 (35mm) spacer

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ASC-35
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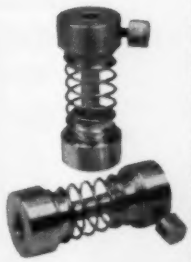

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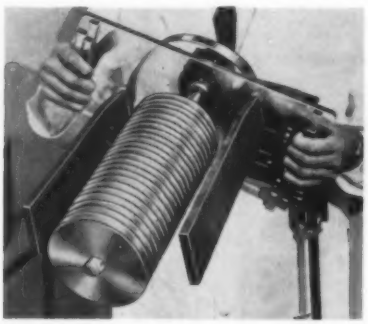

A new hypo and silver recovery unit, called the Rotex, is claimed to be 95% effective. Usable silver in bulk form is recovered from hypo solutions by utilizing an entirely new process which involves both physical-chemical and electrolytic principles. The manufacturer of the unit reports that Rotex not only saves silver, but also cuts hypo costs 80% by reactivating the used solution. The development of this equipment was described in the August 1956 *Journal*, pp. 429–431.

The device is marketed to photofinishers, industrial film processors, X-ray laboratories and radiologists. Price of the complete unit is $395. For further particulars, write W. B. Snook Mfg. Co., Inc., 751 Loma Verde Ave., Palo Alto, Calif.

Pyral, the French manufacturing firm offering magnetic-striping equipment, has issued an information bulletin telling something about the history of the company and describing the services it now has to offer to the industry. In the thirties Pyral developed a process for coating recording disks which was adopted in this country by Audio Devices and in England by E.M.I. With the coming of magnetic recording, Pyral concentrated on this medium and now specializes in the manufacture of prestriped magnetic recording film, both 16mm and 35mm, and of magnetic-striping machines. The bulletin also offers some technical advice on how to shoot and edit films with magnetic striping. The text is in English. Copies may be obtained by writing to Société Pyral, 47 Rue de l'Echat, Créteil (Seine), France.

Foreign language versions of business films are now being produced by the combined efforts of the Berlitz Translation Service, 50 Rockefeller Pl., New York 20, and Tom Boggs Organization, Inc., 595 Madison Ave., New York. Sponsored industrial and commercial motion-picture and slide films, including films for training and instruction, can be converted to polyglot versions.

J. G. McAlister, Inc., announces that their complete line of lighting and production equipment is now available in Canada through Cinequipment International's new Toronto headquarters. Producers are asked to visit or write Cinequipment International, 88 Fourteenth St., Toronto 14, Canada for information regarding sales or rentals.

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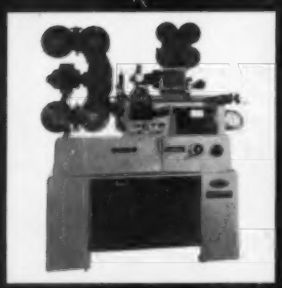

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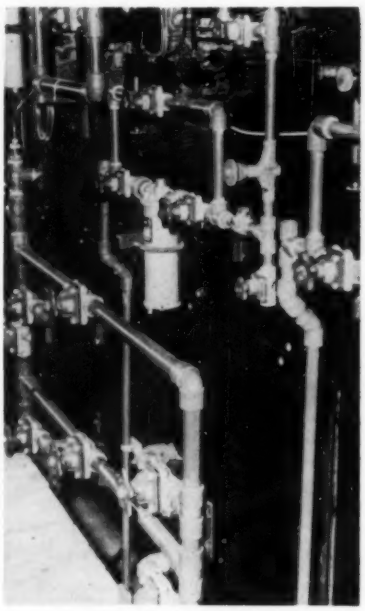


A new plastic piping material has been installed by Pathecolor, Inc., in its new color processing plant at Bayonne, N.J. Ten thousand feet of rigid polyvinyl chloride pipe is in use in the circulating and replenishing systems of the new Kodachrome and Kodacolor processing machines, and in the paper processing systems.

The pipe conveys potassium ferricyanide in 5% solution at 80 F, sulfuric acid 1% solution at 80 F, and hydrobromic acid 3 to 4% solution at room temperature. The Alloy Tube Div. of The Carpenter Steel Co., Union, N.J., which supplied the pipe, says that it is completely resistant to all of the chemicals involved and that product purity is assured because there is no plasticizer in the pipe to contaminate the chemical solutions used.

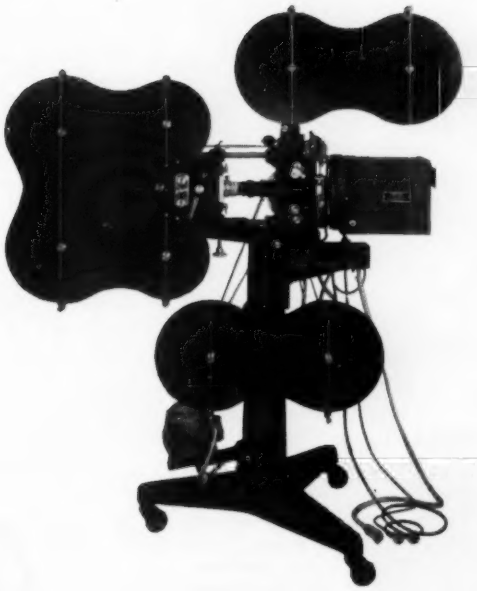
The pipe, reported to require virtually no maintenance, was installed in one-fifth the time that steel pipe would have called for. Changes in the piping system are facilitated by the fact that the pipe can be cut in seconds with a hacksaw and reassembled in a few minutes in almost any manner desired. Fittings are of the socket type, and are installed by cleaning with methyl ethyl ketone, applying a solvent cement, pushing the fitting onto the pipe, and twisting it 90° into place.

Used in the Pathecolor installation are ½-, ¾-, 1-, 1¼- and 2-in. pipe sizes, and various fittings including tees, elbows, reduction bushings, unions, and needle and gate valves. The manufacturer says that the pipe is a normal impact grade having high resistance to acids, high strength, toughness and rigidity, and that it withstands both oxidizing and reducing conditions. Corrosion resistance is such that Pathecolor is said to expect at least 10 years service from the new piping system.

Super Cinex, a lamp system designed for the special screen-brightness requirements of giant indoor and drive-in theaters has been announced by Radio Corp. of America, RCA Theatre Equipment, Camden, N. J. The system when operated at 155

DEPUE

Optical Reduction Printer



The Depue Reduction Printer has been a leader and pioneer in the film printing business, and for more than a quarter of a century has served the industry and laboratories—and served them well!

It is our continuous objective to maintain that leadership and continue to design and manufacture reduction printers that will enable you to do quality printing in an efficient manner.

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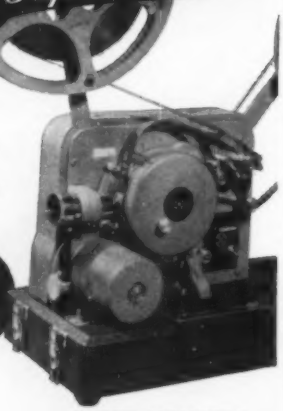

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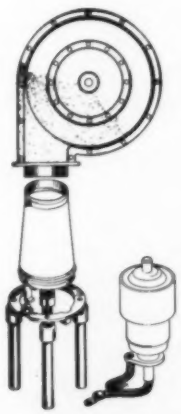
amp with a 13.6mm high-intensity positive carbon is reported to provide considerably more available light on screen with better distribution than lamp systems operated at 125 amp with a 11mm positive carbon. The newly developed system features a high optical speed of *f*/1.6 and includes a Super Cinex arclamp, a 12-phase selenium rectifier and an a-c 9-gal water recirculator with radiator and radiator fan. The system also features a specially designed power supply, built around the 12-phase selenium rectifier, to provide uniform, constant power up to 165 amp.

Various types of anechoic chambers (enclosures echo-free within a specific sound frequency range) are described in a booklet issued by the Eckel Corp., 155 Fawcett St., Cambridge 38, Mass. One of the newer types is a portable chamber designed for scaled-down testing of small microphones and miniaturized electronic equipment. The booklet is available from the company upon request.

A new brochure on fused quartz has been published by Amersil Co., Inc., one of the Engelhard Industries. It also covers fused silica and the uses of these materials in furnaces, laboratory equipment, lamps, optical assemblies and chemical apparatus. The booklet is available from Amersil, at 685 Ramsey Ave., Hillside 5, N.J.

Magnecord, Inc., a division of Midwestern Instruments, Inc., Tulsa, has issued a new catalogue of its entire line of professional magnetic tape recorders. The 15-page catalogue is illustrated by photographs and contains specifications of all models. It is available from the factory at 1101 S. Kilbourn Ave., Chicago 24.



A low-cost socket for high-power, high-frequency tubes has been announced by the Radio Frequency Co., 44–46 Park Street, Medfield, Mass. The socket is especially designed for use with tubes such as the 3X2500-A and F3 and the 3X-3000Al and Fl, and similar tubes with an anode of 4¼ in. A part of the new design is the ring-type contact all around the anode, to help eliminate hot spots. It accommodates a 1-, 2-or 3-tube design. A ring clamp is provided for mounting a silicone rubber air duct for bringing air from a blower to cool the tube. The base price of the socket is $24.50.

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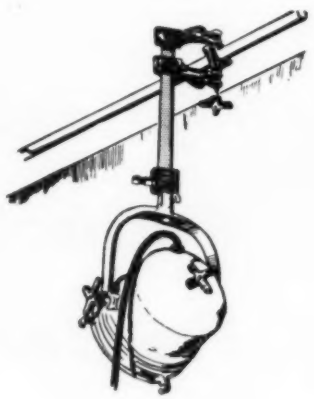

The Grover Grip, a product of the Natural Lighting Corp., 612 W. Elk Ave., Glendale 4, Calif., is designed to solve the problem of attaching bulky lighting equipment to large spans, such as doorways with moldings, desk drawers or wide tables, or across the tops of movie flats or partitions.

The new grip consists mainly of a carpenters type of clamp with a span of 8¼ in. adjustable to round or flat surfaces. The unused portion of the bar supports a small pad which may be revolved. This in turn has studs on it for either ½- or ⅝-in. bushings. The studs are undercut so that lamps may be revolved without marring. A fast-threaded screw with a handle tightens the clamp to the width of the surface to be applied. The pad is then moved along the remaining portion of the bar to hold the light in the desired position. The V block for round surfaces and the flat pad end are rubber-protected to guard against marring polished surfaces.

The grip is reported to be able to maintain a 750-w spot in a horizontal position. It is priced at $6.85. An accessory that provides an adjustable radiator hose-type clamp adaptable to either standard or porcelain screw sockets for the use of ordinary reflectors is priced at $1.85. The grip is 15 in. long and weighs 1¾ lb.

The firm of United Catalog Publishers, Inc., has moved from 106 Lafayette St, New York, to its own building at 60 Madison Ave., Hempstead, N.Y. A new catalog service, Audiofile, for hi-fi and sound distributors, will be at the same address. Pricing Service and File-O-Matic also occupy space on the premises. The firm publishes The Radio-Electronic Master, a buying guide for the industry.

Why SOUND MASTERS Selected... The **ARRIFLEX 35** Model IIA To Shoot ***'Speechless By Mistake'*** for the Bell System

The Bell System wanted a color film that would help prevent accidental damage to buried and aerial telephone cables by dramatizing some of the common causes of such damage and their effect on vital communications. SOUND MASTERS of New York was selected to make the film.

The script called for 'on location' filming — in fields, on highways, in ditches, on 'Main Street'. More than 95% of the film required live, lip-synchronized sound. A versatile, easily maneuverable camera was needed for this job.

SOUND MASTERS selected the Arriflex 35 Model IIA with Synchronous Motor and Sound-Proof Blimp — and filmed all the sequences with this equipment within a period of five weeks. *Speechless By Mistake* has been completed and will soon be released by the local Bell Telephone Companies for public showings.

Says Mr. F. C. Wood, Jr. vice president in charge of production, "We acquired and used the Arriflex outfit because it was the lightest, most compact equipment we could find. It would have been next to impossible to have done the job so quickly and easily with any other camera. The Blimp was perfect both indoors and out.

"Needless to say, we were pleased with the results, as was also the client. The pictures were rock steady and needle sharp — thanks to the new film gate and intermittent, and to those wonderful Schneider lenses. The whole film was a complete success.

"The most wonderful thing about the whole deal is that the price of the complete outfit was hardly more than what it would have cost us to rent other equipment."

And Mr. Wood's experience is, by no means, different or unique, for many other producers and cameramen have discovered the economy, the quality and the versatility of the Arriflex 35. No more easily manageable camera exists anywhere. Yet, it has every facility and convenience for truly first-rate filming.

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The Lawrence Color Television Tube has been licensed to Litton Industries by Chromatic Television Laboratories, Inc., a subsidiary of Paramount Pictures Corp. Plans are to use the tube in radar and air traffic control, and Litton has also acquired the Emeryville, Calif., facilities of Chromatic Television Laboratories, where the Lawrence tube, the invention of Dr. Ernest O. Lawrence, is produced. Proposed military uses of the tube include simplified identification of enemy aircraft. Hostile aircraft can be shown in one color and friendly planes in another on a radar screen. Bombers and fighter planes can also be differentiated by color. The Lawrence tube may also be used to analyze ground operations from the air, with the identification of moving objects in one color and stationary objects in another.

The Lawrence tube has also been licensed to Allen B. Du Mont Laboratories which plans to incorporate it in home receiver sets.

Altec Lansing Corp. has announced the opening of its new sound products plant at 1515 S. Manchester Ave., Anaheim, Calif. The huge building, completed at a cost of 1¼ million dollars, houses such advanced engineering facilities as an anechoic chamber, large design laboratories and modern production machinery to move products through all stages of manufacture including packing and shipping. Altec's corporate offices and central headquarters are also in the new building.

Raytone Screen Corp., 165 Clermont Ave., Brooklyn 5, N.Y., has developed a "High Density" White Screen Paint that is a much thicker version of the firm's Super White. Applied with a roller, this extra-heavy paint results in an uneven texture, much like an orange-peel effect, to give a surface which resists hot-spots (highlights) during rain and helps eliminate some other tower imperfections.

Fourteen different models of drive-in theater screens are shown in a booklet recently issued by Selby Industries, Inc. Each model is pictured on a separate sheet, with complete description and listing of the various general characteristics of a Selby tower, the different sizes of the towers, the types of construction, etc. The new brochure points out that Selby towers are designed to withstand hurricane winds of up to 125 mph and that no tower of this design has ever been reported to have blown down. The towers are guaranteed insurable and acceptable to all building authorities. For a copy of the brochure, write Selby Industries, Inc., 1350 Ghent Hills Road, Akron, 13, Ohio.

A fully transistorized 15-lb portable amplifier for use in remote radio and television broadcast service has been made available commercially by the Radio Corp. of America. The amplifier, BN-6A, a four-channel type, is designed to provide the amplification and control facilities necessary for transmission of remotely originated signals to a broadcast studio via telephone lines. It will also have application in closed-circuit TV service and as a remote mixer for industrial and school sound systems.

A stabilizing amplifier designed to eliminate such low-frequency disturbances as hum, bounce, surges and tilt in both monochrome and color television transmissions has been announced by Radio Corp. of America, Broadcast and TV Dept., Camden, N. J. Known as the TA-9, the amplifier measure 19 × 14 × 5 in.

Kodak Wratten Filters, an Eastman Kodak Data Book, has been revised to include the latest information available on characteristics and uses of these filters. The 80-page booklet includes colorimetric coordinates and luminous transmittance values for both tungsten light and daylight for all filters listed. Chromaticity diagrams show the colors of the various Wratten Filters when they are illuminated by either tungsten light or daylight. The new publication has sections on Wratten filters for photomechanical work, additional filters for exposing Kodak color films and special new filters for densitometry of color films and papers. The booklet is available from Kodak dealers at a price of 75 cents.

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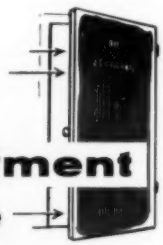

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Administrative Engineer. The SMPTE's Staff Engineer, Henry Kogel, is seeking a new position, after 6 years working with SMPTE Engineering Committees and the motion-picture standards program; also serving as Secy, American Standards Assn. Sec. Committee PH22, and Tech. Secy, International Standardization Orgn. Tech. Com. 36, Cinematography; 2 years, previously, develop. engr. with Sperry Gyroscope Co.; B.S. Elec. Eng., Columbia Univ., 1948, after military service as radio off.; age, 37; married; N. Y. area pref.; complete résumé upon request—Henry Kogel, 19–24 202 St., Bayside 60, N. Y.; Tel. BAyside 9-3574, or at SMPTE, LOngacre 5-0172.

Photographic Development Engineer. Freelance or consultation. Long experience in design, development and production engineering of both military and commercial motion-picture and still cameras and projectors, enlargers, film editors, lapsed time and sequence cameras, viewers, automatic aperture controls, stereographic, press cameras, etc. Military and commercial references available on request. Write: P.O. Box 601, Jamaica 31, N.Y.

Apprentice Film Editor. Seeks summer position. Currently cinema student at CCNY; previously at UCLA with top grades. Meyer Odze, 1669 Macombs Rd., Bronx 53, N.Y.

Motion Picture and Television Production December graduate of Television Workshop; thorough knowledge of film and television techniques, including film transmission equipment, kinescope recording, optics, film markets, library methods. Specialty film genealogy, set lighting and decorating, and electrical effects. Currently secretary of the Society of Cinema Collectors and Historians. Age 33, married. Résumé on request. Larry Morales, 37-16 55th St., Woodside, N. Y.

Laboratory Engineer. Over 10 years in design, procurement and co-ordination of plant, printing, developing and auxiliary equipment. Esp. interested in film sequence-of-operation planning or similar industrial engineering function in sympathy with MIT degree and experience. Position might be with a lab, producer, ad agency, or TV facility. Fred Bray, 40 Ryerson Place, Closter, N.J. Closter 5-1766J.

Asst. Film Editor. Seeks position in N.Y. area. Will graduate from CCNY in June, completing courses of Inst. of Film Techniques. Currently working 20 hr a week on a major Institute project. Experienced with all cutting room apparatus. Chairman of CCNY Chapter, SMPTE. Morton Schwartz, 1997 Huges Ave., Bronx 57, N.Y.

Cinematographer—Art Director. Graduate university-level motion-picture photography and art-directing courses, Academy of Arts, Holland, 1945–50. Over 3 yr experience in planning and production of TV film presentations and film commercials, incl. writing, direction and coordination. Presently employed as assistant film director and set designer. Speaks French, German, Dutch and English. Desires contact with organization active in film production. Excellent references in U.S., Canada and Europe. Resume on request. G. Van Duyn, Wingham, Ont., Canada.

Positions Available

SMPTE Staff Engineer. Applications invited for position at SMPTE headquarters. Duties involve servicing SMPTE engineering committees and organizing and reporting committee activities at Society Conventions, liaison work for the Society in the establishment of national and international motion-picture standards, and handling engineering inquiries addressed to the Society. The Staff Engineer will also have responsibility for maintaining the technical standards of the Society's test film program and for initiating and supervising the manufacture of new films. Submit full résumé to Executive Secretary, SMPTE, Room 1004, 55 West 42 St., New York 36.

Sales Engineer for sound-on-film 16mm cameras. Start $6,600/yr with opportunity for advancement with established company; this is our 26th year in business, see our ads in your SMPTE Journals. To work in Hollywood office with Sales Manager, handle customers and answer mail, covering sales and service of Auricon 16mm sound-on-film optical and magnetic recording cameras. Technical knowledge of, or experience as 16mm producer, professional cameraman, soundman, or both, is necessary. Also ability to write good technical letters. Send résumé, with references, to: Walter Bach, Berndt-Bach, Inc., 6900 Romaine St., Hollywood 38.

Engineering Director. Top-level engineer required for long-established motion-picture equipment manufacturing concern. Must have long experience with automatic printers, additive and subtractive, and with developing machines; able to discuss equipment problems with customers and explain and demonstrate the company's equipment. Send résumé, with references, to: E.M.B.Y., Apt. 1908, 253 West 72 St., New York, N.Y.

Service Engineer, with good mechanical ability and experience in field of motion-picture lab equipment, automatic printers and developing machines. Write: E.M.B.Y., Apt. 1908, 253 West 72 St., New York, N.Y.

Aerial Photographic Technician sought to take motion pictures and still photographs of equipment under aerial tests. Must be experienced in installation and alignment of aerial cameras, familiar with wiring and control circuits, and be able to operate and trouble shoot aerial camera wiring. Capable of performing laboratory work to produce photographs and records obtained from motion-picture and still cameras and photorecorders, and of supervising all aerial photographic activities. Relocation expenses paid; excellent salaries and working conditions; advancement by merit; company-paid benefits. Write qualifications and experience to: Mr. A. J. Page, Department 334, Personnel Administration, IBM Corporation, Airborne Computer Laboratories, Owego, N.Y.

Representative calling on manufacturers and users of photographic, optical and electronic instrumentation. To represent and solicit new business for photographic engineering firm. Should have contacts among aircraft companies, government agencies and manufacturers and users of light and allied equipment for commercial, industrial or military applications. Inquiries are invited in strict confidence. Foto Engineering Co., 495 Hempstead Turnpike, West Hempstead, L. I., N. Y.

Motion Picture Equipment Sales Representative. Familiar with professional production equipment. Write fully or call Mr. Florman, Florman & Babb, Inc., 68 West 45th St., New York 36. MU 2-2928.

Motion Picture Equipment Maintenance Men. Expert on Mitchells, Bell & Howells, Auricons, Cine Specials, Moviolas, amplifiers, etc. Write fully or call Mr. Florman, Florman & Babb, Inc., 68 West 45th St., New York 36. MU 2-2928.

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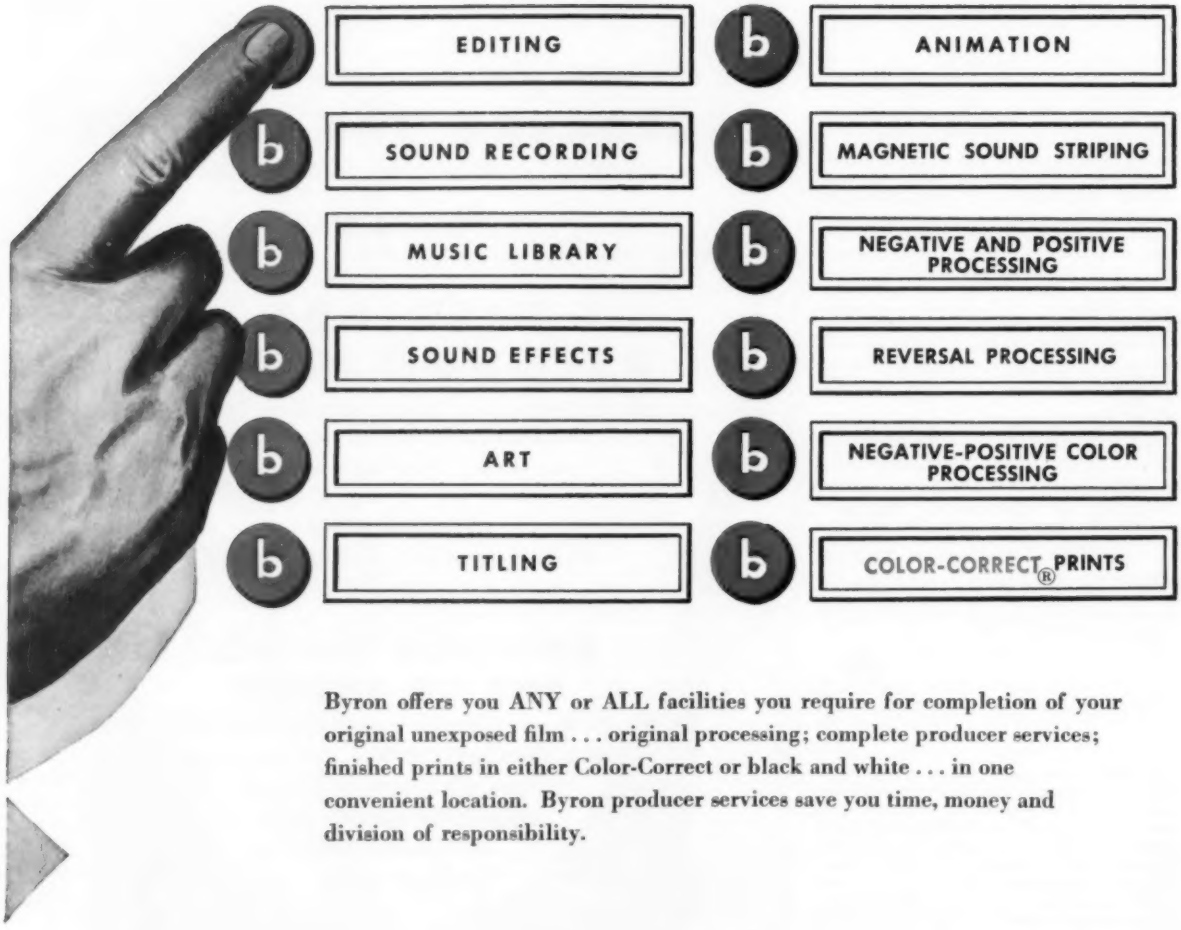

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Meeting Calendar

American Physical Society, Mar. 21–23, U. of Pennsylvania, Philadelphia, Pa.

International Photographic Exposition, Mar. 22–31, National Guard Armory, Washington, D. C.

American Institute of Electrical Engineers, American Society of Mechanical Engineers, Engineering Management Conference, Mar. 27, 28, William Penn Hotel, Pittsburgh, Pa.

American Rocket Society, Spring Meeting, Apr. 3–5, Washington, D. C.

American Chemical Society, Apr. 7–12, Miami, Fla.

National Electrical Industries Show, Apr. 8–11, 71st Regiment Armory, New York.

Armour Research Foundation, Institute of Radio Engineers, Conference on Electronics in Industry, Apr. 9, 10, Illinois Institute of Technology, Chicago.

National Academy of Sciences, Apr. 22–24, Washington, D. C.

Symposium on the Role of Solid State Phenomena in Electric Circuits, Polytechnic Institute of Brooklyn, Apr. 23–25, Engineering Societies Building, New York.

Armour Research Foundation, National Industrial Research Conference, Apr. 24, 25, Conrad Hilton Hotel, Chicago.

American Physical Society, Apr. 25–27, Washington, D. C.

Institute of Radio Engineers, Annual Spring TV Conference, Apr. 26, 27, Engineering Society Bldg., Cincinnati, Ohio.

81st Semiannual Convention of the SMPTE, including Equipment Exhibit, Apr. 29–May 3, Shoreham Hotel, Washington, D. C.

Electronic Components Symposium, May 1–3, Morrison Hotel, Chicago

Acoustical Society of America, May 23–25, New York.

American Society for Testing Materials, June 16–21, Chalfonte-Haddon Hall, Atlantic City, N. J.

American Institute of Electrical Engineers, Summer General Meeting, June 24–28, Montreal, Que.

International Symposium on Physical Problems of Color Television, sponsored by International Union of Pure and Applied Physics, French Physical Society, French Society of Radioelectricians, French Society of Vacuum Engineers, July 2–6, National Conservatory of Arts and Crafts, Paris.

Western Electronic Show and Convention, Aug. 20–23, Cow Palace, San Francisco.

82nd Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 4–9, Philadelphia-Sheraton, Philadelphia.

National Electronics Conference, Oct. 7–9, Hotel Sherman, Chicago.

83rd Semiannual Convention of the SMPTE, including Equipment Exhibit, April 21–26, 1958, Ambassador Hotel, Los Angeles.

84th Semiannual Convention of the SMPTE, Oct. 20–24, 1958, Sheraton-Cadillac, Detroit.

85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 6–10, 1959, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections Subsections and Chapters, and of the Committee Chairmen and Members will be published in the April 1957 Journal.

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